MOTOROLA

GP350

Portable Radios

146-174 MHz
438-470 MHz

Radius

6880904Z07-O

6880904Z07-O

Motorola
Radius Division
Hwy 34 West
Mt. Pleasant, IA 52641

Computer Software Copyrights

Airbag Warning Statement

⚠ WARNING

VEHICLES EQUIPPED WITH AIR BAGS

An air bag inflates with great force. **DO NOT** place objects, including communication equipment, in the area over the air bag or in the air bag deployment area. If the communication equipment is improperly installed and the air bag inflates, this could cause serious injury.

- Installation of vehicle communication equipment should be performed by a professional installer/technician qualified in the requirements for such installations. An air bag's size, shape and deployment area can vary by vehicle make, model and front compartment configuration (e.g., bench seat vs. bucket seats).
- Contact the vehicle manufacturer's corporate headquarters, if necessary, for specific air bag information for the vehicle make, model and front compartment configuration involved in your communication equipment installation.

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Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by instruction manual revision. These revisions are added to the manuals as the engineering changes are incorporated into the equipment.

How to Use This Manual

This manual contains introductory material such as model charts, accessories, and specifications, as well as four sections that deal with specific service aspects of the GP350. Refer to the Table of Contents for a general overview of the manual, or to the "Overview" paragraph in each section for a specific overview of the information in that section.

Other Documentation

Table 1 lists other documentation for the GP350 Portable Radios.

Table 1. Other Documentations

Information	Location
Basic Use of GP350	GP350 User Guide (6880904Z01)
Programming	GP350 RSS Manual (6880904Z09)

Technical Support

To obtain technical support, you may call Motorola's Radius Product Services. When you call, we ask that you have ready the model and serial numbers of the respective radio or its parts.

Service Policy

If malfunctions occur within 30 days that cannot be resolved over the phone with Radius Product Services, a defective major component should be returned. You must obtain authorization from Radius Product Services before returning the component.

Ordering Replacement Parts

You can order additional components and some piece parts directly through your Radius price pages. When ordering replacement parts, include the complete identification number for all chassis, kits, and components. If you do not know a part number, include with your order the number of the chassis or kit which contains the part, and a detailed description of the desired component. If a Motorola part number is identified on a parts list, you should be able to order the part through Motorola Parts. If only a generic part is listed, the part is not normally available through Motorola. If no parts list is shown, generally, no user serviceable parts are available for the kit.

Technical Support (U.S. and Canada)
Radius Product Services
Hwy. 34 West
Mt. Pleasant, IA 52641 USA
1-800-356-1520 (U.S. and Canada)
319-385-5395 (Outside U.S.)

Technical Support (Latin America, Mexico, Caribbean)
1-800-694-2161 (Latin America, Mexico, Caribbean)

Radius 30-Day Warranty
Radius Repair Depot
Attention: Warranty Return
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA
1-800-356-1520
319-385-5395 (Outside U.S.)

Radius Major Component Repair
Radius Repair Depot
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA

Motorola Parts
Americas Parts Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Customer Service Motorola Parts
1-800-422-4210
1-708-538-8198 (FAX)

Parts Identification
1-708-538-0021
1-708-538-8194 (FAX)

Model Charts

GP350
VHF
146 - 174 MHz

X = Indicates one of each required

Model	P93MGC20A2A_	P93MGC20C2A_		
Description	2-Chan., 20/25 kHz (146-174 MHz)	16-Chan., 20/25 kHz (146-174 MHz)	**Item**	**Description**
	X	X	HHN9126_	Housing
	X		HLD9440_	RF Board, 2-Chan., 20/25 kHz, (146-174 MHz)
		X	HLD9441_	RF Board, 16-Chan., 20/25 kHz, (146-174 MHz)
	X	X	HLN8255_	Spring-Action Belt Clip, 3”
	X	X	HLN9152_	Chassis Hardware Assembly
	X		HLN9202_	2-Channel Control Kit
		X	HLN9203_	16-Channel Control Kit
	X	X	NAD6502_	Antenna (146-174 MHz)
	X	X	6880904Z01	Users Guide/Quick Reference Card

GP350
UHF
438 - 470 MHz

X = Indicates one of each required

Model	P94MGC20A2A_	P94MGC20C2A_						
Description	2-Chan., 20/25 kHz (438-470 MHz)	16-Chan., 20/25 kHz (438-470 MHz)					**Item**	**Description**
	X	X					HHN9126_	Housing
	X						HLE9480_	RF Board, 2-Chan., 20/25 kHz (438-470 MHz)
		X					HLE9481_	RF Board, 16-Chan., 20/25KHz, (438-470 MHz)
	X	X					HLN8255_	Spring-Action Belt Clip, 3”
	X	X					HLN9152_	Chassis Hardware Assembly
	X						HLN9202_	2-Channel Control Kit
		X					HLN9203_	16-Channel Control Kit
	X	X					NAE6483_	Antenna
	X	X					6880904Z01	User Guide /Quick Reference Card

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Accessories

Antennas:

NAD6502_R	— Black	146-174 MHz VHF Antenna (Standard w/Unit)
HAD9742	— Black	146-162 MHz VHF Stubby Antenna
HAD9743	— Blue	162-174 MHz VHF Stubby Antenna
NAE6483_R	— None	403-520 MHz UHF Antenna (Standard w/Unit)
NAE6521_R	— Red	400-440 MHz UHF Stubby Antenna
NAE6522_R	— Green	438-470 MHz UHF Stubby Antenna
HAD9728	— None	Tunable Antenna Kit (136-174 MHz)

Note: Each of the color coded antennas listed is designed to cover only the frequency split indicated. Therefore, it is important to order the correct antenna (frequency split) to match a specific customer frequency.

Carrying Accessories:

HLN9417	Standard Leather Carry Case w/Belt Loop
HLN9323	Standard Leather Carry Case w/Swivel
HLN9416	Standard Nylon Carry Case
HLN9420	DTMF Standard Leather Carry Case w/Belt Loop
HLN9418	DTMF Standard Leather Carry Case w/Swivel
HLN9724	2-1/2” Belt Clip
HLN8255	Replacement Heavy Duty Spring Action 3” Belt Clip
HLN8052	Wrist Strap
NTN5243	Shoulder Strap (for all carry cases)
HLN8414	Chest Pack Carry Holder
42-5857B04	Replacement 3” Swivel Belt Loop (for use with same carry accessories as 2-1/2” Belt Loop but with wider belts)
42-5857B05	Replacement 2-1/2” Swivel Belt Loop (for use with HLN9323, HLN9418)
42-80532B01	Replacement Strap for Nylon and Leather Carry Cases
42-80532B02	Replacement Strap for DTMF Carry Case
HLN9985	Waterproof Bag

Nickel-Cadmium Battery Chargers:

HTN9630	120 Volt - 1 Hour Rapid Rate Charger
HTN9702	120 Volt - 10 Hour Standard Rate Charger
HTN9748	120 Volt - 6 Unit - 1 Hour Rapid Rate Charger
HTN9802	220 Volt - 1 Hour Rapid Rate Charger (European Plug)
HTN9804	220 Volt - 10 Hour Standard Rate Charger (European Plug)
HTN9811	220 Volt - 6 Unit - 1 Hour Rapid Rate Charger (European Plug)
HTN9803	240 Volt - 1 Hour Rapid Rate Charger (U. K. Plug)
HTN9805	240 Volt - 10 Hour Standard Rate Charger (U. K. Plug)
HTN9812	240 Volt - 6 Unit - 1 Hour Rapid Rate Charger (U. K. Plug)
HLN9719	1 Hour Vehicular Charger Adapter/Bracket (12 volt for use with HTN9630 Rapid Rate Charger)
HLN9944	Wall Mounting Bracket For Multi Unit Charger

Batteries:

HNN9360	1200 mAH High Capacity Battery (Standard)
HNN9361	1200 mAH (Fully Approved FM Battery)

Audio/RF Accessories:

HMN9041	Remote Speaker Microphone (with GP350 connector)
BDN6720*	Earpiece Without Volume Control (plastic earloop)
HMN9752_R*	Earpiece With Volume Control (plastic earloop)
50-80386B90	Rubber Ear Inserts for Earpieces (with older metal earloop - pkg q. 25)
50-80371E73	Rubber Ear Inserts for Earpieces (with plastic earloop - pkg q. 25)
HMN9754_R*	2 Piece Surveillance Microphone (plastic earloop)
HMN9013*	Light Weight Headset II
BDN6647*	Medium Weight Single Speaker Headset w/Swivel Boom Microphone (compatible with Internal VOX)
HMN9021*	Medium Weight Dual Muff Headset w/Swivel Boom Microphone (Over the Head)
HMN9022*	Medium Weight Dual Muff Headset w/Swivel Boom Microphone (Behind the Head)
BDN6648*	Heavy Weight Headset w/Noise Cancelling Boom Microphone with PTT button (compatible with Internal VOX)
BDN6646*	Ear Microphone with PTT Interface
BDN6706*	Ear Microphone w/VOX Interface (External VOX Included)
HLN9756	BNC - RF Adapter (for use with P110, GP300 and GP350 models only)
HLN9482	GP300 to GP350 Accessory Adapter

Prices And Availability Subject To Change Without Notice

* Accessories marked with an asterisk (*) require the HLN9482 (GP300 to GP350 Adapter Kit) for use on GP350 radios.

Performance Specifications

GENERAL

	VHF		UHF			
Model Series:	P93MGC		P94MGC			
Frequency:		146-174		438-470		
Channel Capacity:	2 or 16 channels			2 or 16 channels		
Power Supply:	One (1) rechargeable Nickel-Cadmium battery (7.5V)					
Dimensions†:	5.54” X 2.48” X 1.79” (142 X 63X 45.6mm)†					
Weight †:	17.8 oz. (509 g)†					
Average Battery Life (5-5-90 Duty Cycle): High Capacity:	Low Power 10.5 Hours	High Power 8 Hours	Low Power 10.5 Hours		High Power 8 Hours	
Environmental:	Meets MIL-STD-810-C, D, and E & EIA RS-316B environmental specifications for vibration, shock, rain, dust, and humidity					

†Standard High Capacity Battery Model

TRANSMITTER

	VHF		UHF	
RF Output @ 7.5V:	High 5W	Low 1W	High 4W†	Low 1W
Freq. Separation:	26, 28 MHz		30, 32 MHz	
Freq. Stability (-30˚C to +60˚):	±0.0005%			
Modulation:	±5 kHz max. (25/30 kHz channel spacing) ±2.5 kHz max. (12.5 kHz channel spacing)			
Spurs/Harmonics:	0.25 µW < 2GHz			
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz	+1, -3 dB			
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<3%			
FCC Designation:	AZ489FT3784 AZ489FT3785		AZ489FT4802 AZ489FT4803 AZ489FT4804 AZ489FT4805	
FM Noise:	-40 dB‡			

†Max.RF output is 3W for frequencies greater than 512 MHz
‡Typical level

RECEIVER

	VHF		UHF	
Channel Spacing:	25 kHz	12.5 kHz	25 kHz	12.5 kHz
Freq Separation:	26, 28 MHz		30, 32 MHz	
Sensitivity - 20 dB Quieting†: 12 dB EIA SINAD†: 20 dB SINAD†:	 0.32 µV 0.22 µV 0.30 µV	 0.38 µV N/A 0.35 µV	 0.32 µV 0.22 µV‡ 0.30 µV	 0.38 µV N/A 0.35 µV
Squelch Sensitivity:	10 dB SINAD			
Selectivity:	70dB	60dB	70dB	60dB
Intermodulation	70dB	60 dB	70 dB	60 dB
Freq. Stability (-30˚C to +60˚C): (-10˚C to +50˚C):	 0.0005% 0.0003%			
Spur Rejection EIA: CEPT:	 75 dB 70 dB			
Image Rejection EIA: CEPT:	 75 dB 70 dB		 70 dB 70 dB	
Audio Output at<10% Distortion (1 kHz)	500mW			

†Typical specification is 0.28mV on frequencies greater than 512 MHz

***All specifications subject to change without notice.**

Service Aids

The following table lists service aids recommended for working on the GP350.

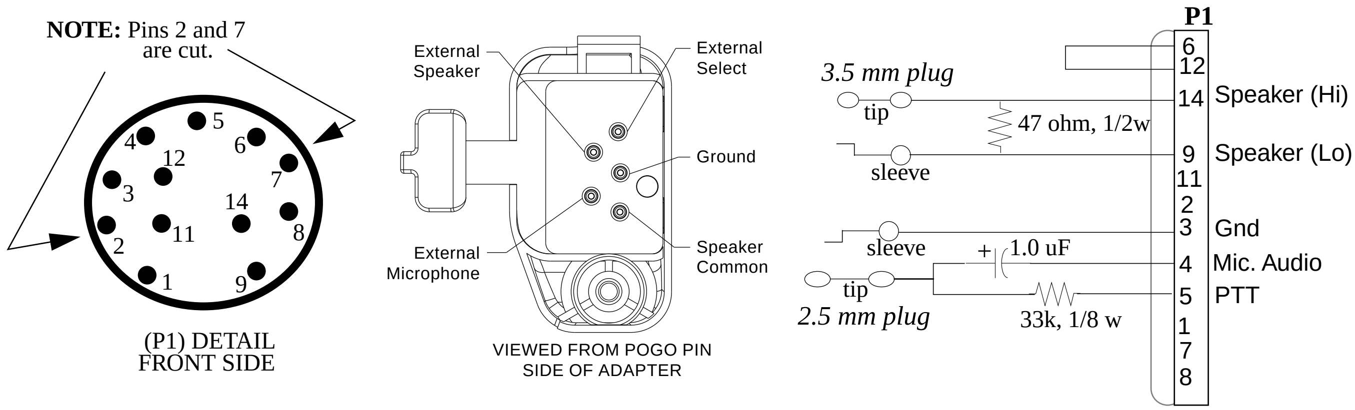
Motorola Part No.	Description	Application
HLN9214	Radio Interface Box	Enables communication between the radio and the computer's serial communications adapter.
HSN9412	RIB Power Supply	Used to supply power to the RIB.
HKN9216	Computer Interface Cable	Connects the computer's serial communications adapter to the RIB.
HLN9390	AT to XT Computer Adapter	Allows HKN9216 to plug into a XT style communications port.
HKN9857	Programming / Test Cable	Connects radio to RIB. And can be used as a Battery Eliminator.
HVN9128	Radio Service Software	Software on 3-1/2 in. diskette
HLN9482	GP300 to GP350 Accessory Adapter	Allows use of the RKN4034 Test Set Cable with the GP350 radio.
RTX4005	Portable Test Set	Enables connection to the audio / accessory jack. Allows switching for radio testing.
RKN4034	Test Set Cable	Connects radio to RTX4005B Test Box.
REX1143	Programming Adapter Kit	Connects radio to programmer (HKN9857)

Test Equipment

The following table lists test equipment required to service the GP350 and other two-way radios.

Motorola Model No.	Description	Characteristics	Application
R2200, R2400, or R2001D with trunking option	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049A	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements
*S1100A	Audio Oscillator	67 to 161.4Hz tones	Used with service monitor for injection of PL tones
*S1053D, *SKN6009A, *SKN6001A	AC Voltmeter, Power Cable for meter, Test leads for meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 Mhz bandwidth, 5mV/cm - 20V/cm	Waveform measurements
*S1350C, *ST1215B (VHF) *ST1223B (UHF) *T1013A	Wattmeter, Plug-in Elements (VHF& UHF), RF Dummy Load	50-ohm, ± 5% accuracy 10 Watts, maximum 0-1000 Mhz, 300W	Transmitter power output measurements
S1339A	RF Millivolt Meter	100uV to 3V rf, 10 khz to 1.2 Ghz	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity
S1347D or S1348D (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 10Vdc

Test Set Service Cable



NOTE: For proper speaker impedance, the RTX4005B test set *Audio out* switch must be set to the **“MX”** position

Figure 1. Service Cable (RKN4034A) for the Test Set (RTX4005B)

Radio Model Information

The model number, serial number, and Motorola FCC designation number are all on a label attached to the back of your radio. From this model number, you can determine the RF output power, frequency band, type of squelch, and number of channels. The table below outlines one portable radio model number and its specific characteristics.

All GP350 radio models are synthesized, two or sixteen channel units that come standard with tone Private-Line (TPL) or Digital Private-Line (DPL) coded squelch, which may be enabled / disabled on a per channel basis. Programming changes can be made by your local Motorola Radius dealer.

Radio Model Number (Example: P94MGC20C2AA)

Type of Unit	Tx Power	Freq.	Model Series	Channel Spacing	Channel Capability	Frequency Sub-band	Version	Unique Model Variation
P	**9** 1-5 W VHF 1-4 W UHF	**3** VHF	**MGC** Universal	**00** 12.5 kHz	**A** 2 Channels	**1** Low Split	**A**	
		4 UHF		**20** 20/25 kHz		**2, 3 or 4** High Split		**A**
					C 16 Channels			

P = Portable

A = Package Model with Battery, Antenna, Belt Clip, Charger.

Radio Service Software Information

To run the Radio Service Software, you will need the following equipment:

Required Equipment:

1. *IBM XT, AT, Convertible, or System/2 Model 30/50*™ with 512K RAM, Dual Floppy Disk Drives or on Floppy Disk and one Hard Disk.
2. *PCDOS*™ or *MSDOS*™ 3.0 or later.
3. Radio Interface Box (RIB) **HLN9214.**
4. RIB to *IBM AT* cable **HKN9216.**
5. *IBM AT* cable to *IBM XT* computer adapter (optional) **HLN9390.**
6. Programming/Test cable (HKN9857).
7. Programming Hardware Kit (REX1143).
8. RIB power supply **HSN9412** (110 VAC) or 0180358A56 (220 VAC).
9. Power Supply R1011A or equivalent.

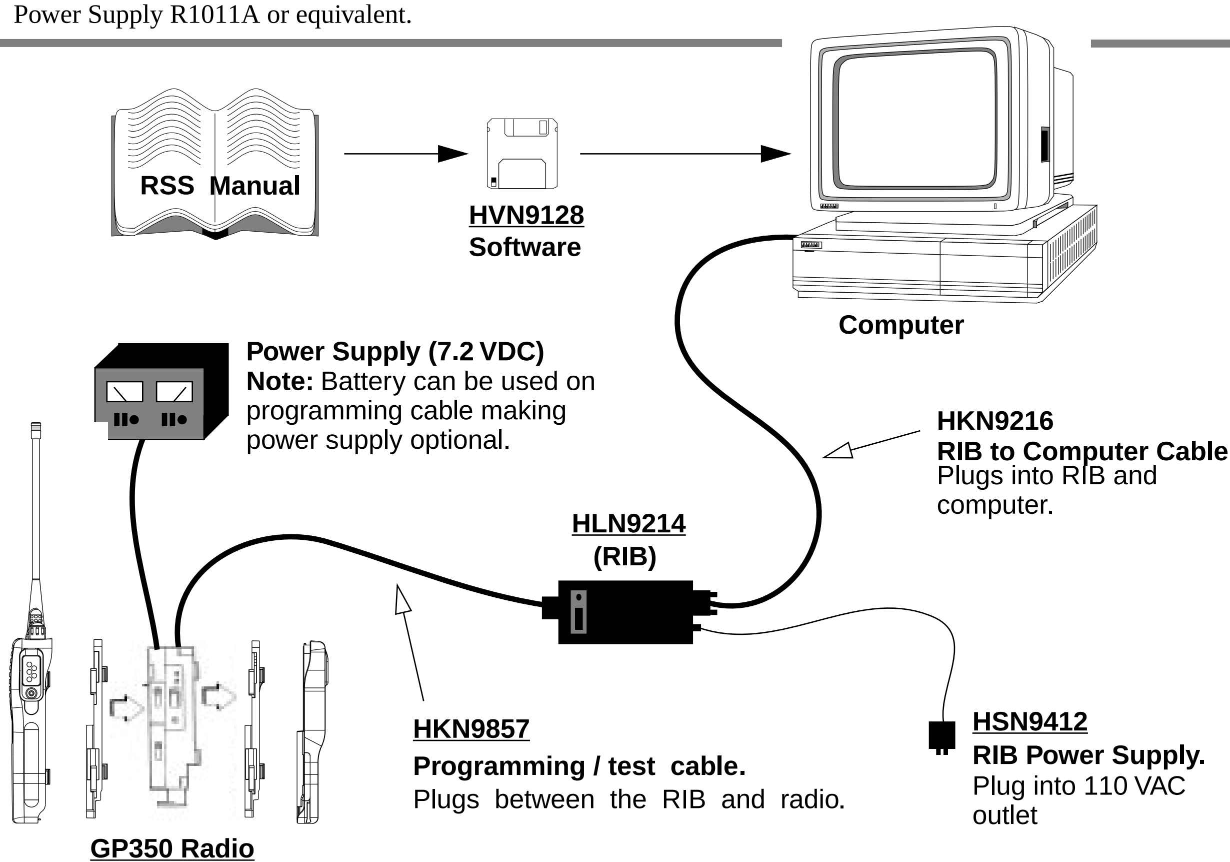


Figure 2. Equipment Setup

Configuring the RIB and Radio

1. Connect the RIB to the computer (Figure 2).
2. If your computer has an XT style communications port (25 pin connector), plug the HLN9390 adapter into the computer and plug the HKN9216 cable into the adapter. If you are unsure of which connection is on the back of your computer or the COM port, then please consult the computer manuals.
3. Plug the large 25 pin end of the HKN programming cable into the RIB. The other end of this cable has a “battery eliminator.”
4. Connect the two adapter plates (REX1143) to HKN9857 according to the instructions supplied with the Programming Hardware Kit.
5. Slide the battery eliminator in place of the radio’s battery.
6. Plug the HSN9412 power supply into a wall outlet, and connect the other end to the RIB.
7. Connect the radio to a power supply and turn the volume control clockwise to turn it on.

Section 1
Safety Information

General

This manual includes specifications, fundamental disassembly/reassembly procedures, schematic diagrams, component location diagrams, flex circuit diagrams, several parts lists, theory of operation, and troubleshooting sections to cover the GP350 radios. Hereafter, the text will refer collectively to the GP350 radios as “this family of radios.” For operation of the radio, refer to the applicable manual available separately.

Throughout the text in this publication, you will notice the use of warnings, cautions, and notes. These notations are used to emphasize that safety hazards exist, and care must be taken and observed.

WARNING

An operational procedure, practice, or condition, etc., which may result in injury or death if not carefully observed.

CAUTION

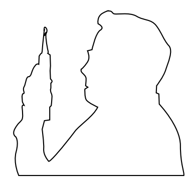
An operational procedure, practice, or condition, etc., which may result in damage to the equipment if not carefully observed.

NOTE

An operational procedure, practice, or condition, etc., which is essential to emphasize.

FCC Safety Information

The Federal Communications Commission (FCC), with its action in General Docket 79-144, March 13, 1985, has adopted a safety standard for human exposure to radio frequency (RF) electromagnetic energy emitted by FCC-regulated equipment. Motorola subscribes to the same safety standards for the use of its products. Proper operation of this radio will result in user exposure substantially below the FCC recommended limits.



- *Do not* hold the radio with the antenna very close to, or touching, exposed parts of the body, especially the face, ears, or eyes, while transmitting. Hold the radio in a vertical position with the microphone two to three inches away from the lips.
- *Do not* hold the transmit switch (PTT) on when not actually desiring to transmit.
- *Do not* allow children to play with any radio equipment containing a transmitter.
- *Do not* operate this equipment near electrical blasting caps or in an explosive atmosphere. Under certain conditions, radios can interfere with blasting operations. When you are in the vicinity of construction work, look for, and observe, signs cautioning against radio transmission. If radio transmission is prohibited, you must not transmit until out of the area. Furthermore, you must turn off your radio to prevent any accidental transmission.
- *Do not* replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion.
- Turn radio off when removing or installing a battery.

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FMRC Approved Equipment

Anyone intending to use a radio in a location where hazardous concentrations of flammable material exist (hazardous atmosphere) is advised to become familiar with the subject of intrinsic safety and with the National Electric Code NFPA 70 (National Fire Protection Association) Article 500 (hazardous [classified] locations).

An Approval Guide, issued by Factory Mutual Research Corporation (FMRC), lists manufacturers and the products approved by FMRC for use in such locations. FMRC has also issued a voluntary approval standard for repair service (“Class Number 3605”)

FMRC Approval labels are attached to the radio to identify the unit as being FM Approved for specified hazardous atmospheres. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used. Their Approval mark is shown below.

FM
APPROVED

WARNING

Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (e.g. FMRC Approved) for such use. An explosion or fire may result.

Do not operate the FMRC Approved Product in a hazardous atmosphere if it has been physically damaged (e.g. cracked housing). An explosion or fire may result.

Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.

Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.

Do not operate the FMRC Approved Product unit in a hazardous location with the accessory contacts exposed. Keep the connector cover in place when accessories are not used.

Turn radio off before removing or installing a battery or accessory.

Do not disassemble the FMRC Approved Product unit in any way that exposes the internal electrical circuits of the unit.

Radios must ship from the Motorola manufacturing facility with the hazardous atmosphere capability and FM Approval labeling. Radios will not be “upgraded” to this capability and labeled in the field.

A modification changes the unit’s hardware from its original design configuration. Modifications can only be done by the original product manufacturer at one of its FMRC audited manufacturing facilities.

WARNING

Failure to use an FMRC Approved Product unit with an FMRC Approved battery or FMRC Approved accessories specifically approved for that product may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.

Unauthorized or incorrect modification of an FMRC Approved Product unit will negate the Approval rating of the product.

Repair of FMRC Approved Products

REPAIRS FOR MOTOROLA FMRC APPROVED PRODUCTS ARE THE RESPONSIBILITY OF THE USER.

You may want to consider using a repair facility that operates under 3605 repair service approval.

WARNING

Incorrect repair or relabeling of any FMRC Approved Product unit could adversely affect the Approval rating of the unit.

Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.

FMRC’s Approval Standard Class Number 3605 is subject to change at any time without notice to you, so you may want to obtain a current copy of 3605 from FMRC. Per the December, 1994 publication of 3605, some key definitions and service requirements are as follows:

Repair

A repair constitutes something done internally to the unit that would bring it back to its original condition Approved by FMRC. A repair should be done in an FMRC Approved facility.

Items not considered as repairs are those in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner which exposes the internal electrical circuits of the unit. You do not have to be an FMRC Approved Repair Facility to perform these actions.

Relabeling

The repair facility shall have a method by which the replacement of FMRC Approval labels are controlled to ensure that any relabeling is limited to units that were originally shipped from the Manufacturer with an FM Approval label in place. FMRC Approval labels shall not be stocked by the repair facility. An FMRC Approval label shall be ordered from the original manufacturer as needed to repair a specific unit. Replacement labels may be obtained and applied by the repair facility providing satisfactory evidence that the unit being relabeled was originally an FMRC Approved unit. Verification may include, but is not limited to: a unit with a damaged Approval label, a unit with a defective housing displaying an Approval label, or a customer invoice indicating the serial number of the unit and purchase of an FMRC Approved model.

Do Not Substitute Options or Accessories

The communications equipment package that Motorola submits to FMRC for testing and approval is tested as a system that consists of the communications unit itself and the battery, antenna and other options or accessories that make up the rest of the package to be approved. This approved package must be strictly observed and there must be no substitution of items, even if the substitute you wanted to consider appears as an approved accessory elsewhere in the Guide for some other communications equipment unit. Approved configurations are listed by FMRC Approved Product in the annual Approval Guide published by FMRC. That guide, and the Approval Standard Class Number 3605 document, can be ordered from the following address.

Training Resource Center

Publications-Order Processing Dept.

Factory Mutual Engineering and Research

1151 Boston-Providence Turnpike

PO Box 9102

Norwood, MA, 02062

telephone (617) 762-4300

Section 3
Disassembly/Reassembly

Remove Battery

1. Locate the battery latch on the bottom of the radio. Push the battery latch toward the front of the radio and hold it in the open position as shown in Figure 3-1.

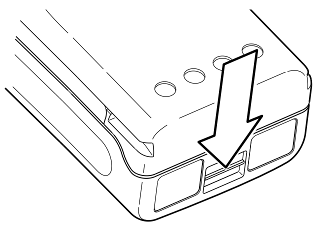


Figure 3-1.

2. While holding the battery latch in the open position, slide the battery down approximately 1/2 inch and then off the radio housing as shown in Figure 3-2.

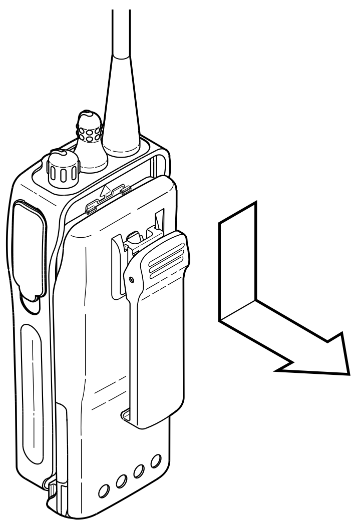


Figure 3-2.

Remove Belt Clip from Battery

1. Push in on tab of belt clip with small flat-bladed screwdriver, and at the same time slide belt clip toward top of radio (Figure 3-3).

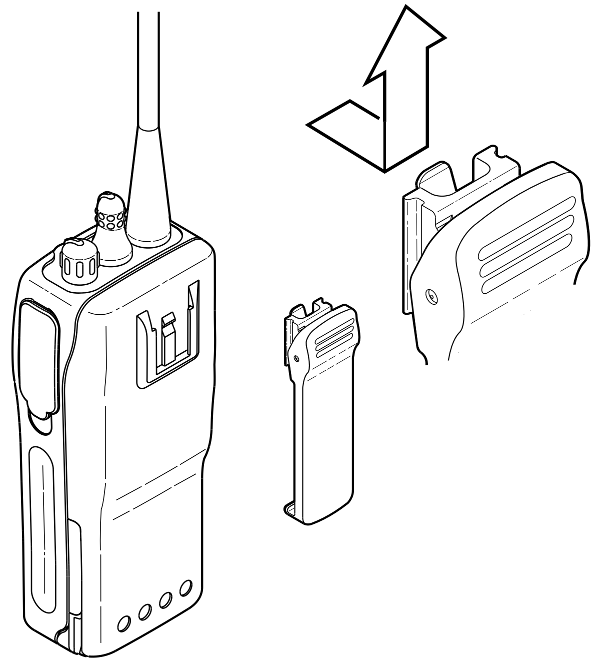


Figure 3-3.

Remove Chassis

1. Pull both control knobs straight off to remove.
2. Unscrew antenna counterclockwise to remove.
3. Using a flat-blade screwdriver, carefully pry chassis up on both sides of slot at bottom center of radio (Figure 3-4).

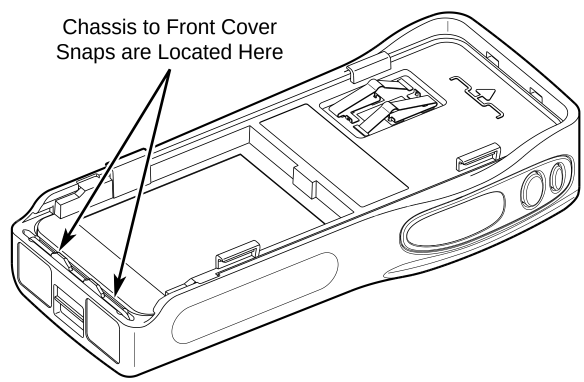


Figure 3-4.

CAUTION
Lift the chassis approximately half way out of the front cover, because you must disconnect the flex cable before completely removing the chassis.

4. Disconnect the flex cable connector using a flat blade screwdriver, as shown in Figure 3-5.

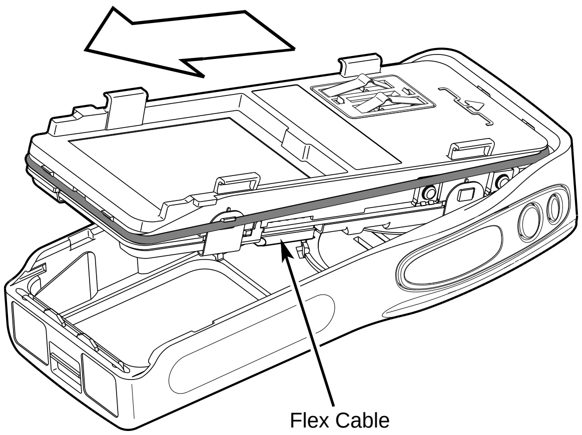


Figure 3-5.

5. Pull the chassis out and away from the housing as shown by the arrow in Figure 3-5.

Remove the Main Board

1. The main board is sandwiched between the front shield and the chassis. Four chassis clips hold the sandwiched assembly together. Remove the chassis gasket and place the radio shield side down on a flat surface.

2. Using a small flat blade screwdriver, unlock the four chassis clips while pressing down on the chassis directly above each clip. (Refer to Figure 3-6.)

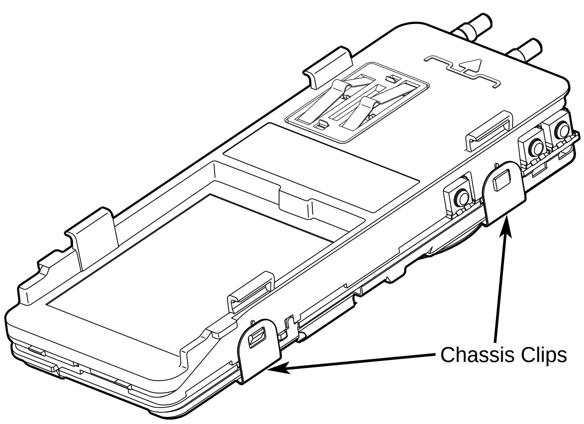


Figure 3-6.

3. After all four chassis clips have been removed, separate the main board from the chassis as shown in the exploded view Figure 3-7.

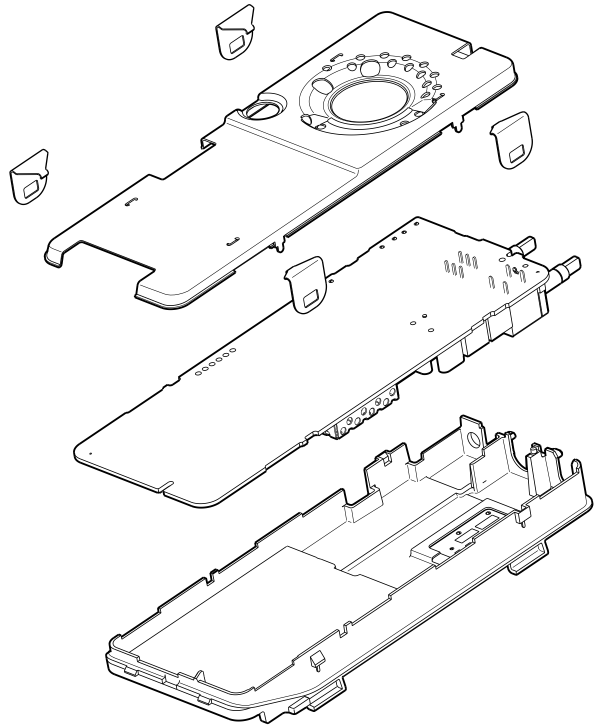


Figure 3-7.

Re-assembly of Radio

Reverse the disassembly procedure.

IMPORTANT

Be sure to reinstall the chassis gasket. This gasket helps keep the main board free of unwanted dirt, dust, and water.

Section 4
Theory of Operation

Overview

This section provides a detailed theory of operation for the GP350 and its components: the microcomputer, the receiver, the transmitter, and the frequency generation circuitry.

Microcomputer

The GP350 VHF and UHF radios use the Motorola 68HC11A8 microcomputer, U401, which utilizes:

- 7.9488 MHz clock rate
- Multiplexed 8-bit address/data lines
- 16-bit addressing
- Internal watchdog circuitry
- Analog to digital conversion input ports

The microcomputer's operating program is permanently written or "masked" within the microcomputer. Included in U401 is an EEPROM memory which stores channel, signalling, and scan list information.

Microcomputer Power-Up and Reset Routine

On power-up U401's reset line (pin 43) is held low by the AFIC (U402) until the synthesizer (U201) provides a stable 2.1 MHz output. When U402 releases its control, U401's hardware holds the reset line low until it verifies that clock Y401 is operational. When the reset line goes "high," U401's hardware delays briefly to allow Y401 to stabilize, then the software begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 ms is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

U401's reset line can be controlled directly by the 5V regulator (U411), the AFIC, and the microcomputer, and indirectly by the synthesizer. U411 drives the reset line low (via pin 3) if it loses regulation. This prevents possible latch-up or overwriting of registers in the microcomputer because the reset line is higher in voltage than pin 55 of U401 (VDD).

U401 can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software stuck in an infinite loop, unplanned hardware inputs, static zaps, etc.

The AFIC and synthesizer can control the reset line during power-up, as outlined above.

Receiver

The receiver of the GP350 UHF and VHF radios consists of 4 major blocks each: the front-end module, the double balanced mixer, the 45.1 MHz IF and the back-end IF IC.

The UHF and VHF front-end modules consist of three blocks of circuitry each: **A pre-selector, RF amplifier and a post-selector filter.** These three items are located on a receiver module pc-board that stands perpendicular to the main radio pc-board. This module is enclosed in a shield to prevent radiation into and out of the module. All filters on the UHF and VHF modules are fixed tuned designs to eliminate the need for factory tuning and to provide wide-band operation.

The shunt and series coupled resonator topology yields a more symmetrical frequency response to guard against strong out of band signals that could produce IM products.

The worst case image frequency in the VHF band is 90.2 MHz above the filter passband. The 3 db bandwidth is approximately 35 MHz, centered at 160 MHz. The center of the band insertion loss is approximately 1.9 db. The 4-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The UHF pre-selector filter is a 3-pole,.01 db Chebyshev bandpass design implemented in a shunt coupled resonator topology. This topology maximizes the attenuation at the worst case image frequency for this receiver, which is 90.2 MHz below the filter passband. The 3 db bandwidth is approximately 45 MHz, centered at 454 MHz. The center of the band insertion loss is approximately 2.2 db. The 3-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The RF amplifier, Q1, is a Motorola MMBR571 NPN device biased in a common emitter configuration. The amplifier is stabilized by the shunt feedback resistor R3, and has approximately 16.5 db of gain with a noise figure of about 3.0 db (VHF) and 2.2 db (UHF). The amplifier draws 4 ma of current and is supplied by the receiver 5 volt supply (indicated as "+5R" on the schematics and block diagrams).

Terminating the RF amplifier is the post-selector filter. This filter is a 3-pole for VHF and a 4-pole for UHF,.01 db Chebyshev design which is also implemented in a series coupled resonator topology for maximum image attenuation. The 3 db bandwidth is approximately 38 MHz centered at 160 MHz for VHF and 42.5 MHz centered at 454 MHz for UHF.

The insertion loss of this filter is approximately 1.9 db for VHF and 3.5 db for UHF. The filter is designed to be terminated with the amplifier output impedance on one side, and 50 ohm on the other.

The net gain from the receiver module is about (12.2 db VHF) (10.8 db UHF) in the center of the band and about (10.7 db VHF) (9.5 db UHF) at the band edges. The net center of the band noise figure is approximately (5.5 db VHF) (5.2 db UHF). This is sufficient to achieve a typical center of the band sensitivity of 12 dbs.

The double balanced mixer is composed of the two baluns, T1 and T2, and the ring diode IC, CR2. The mixer operates with a local oscillator (LO) level of +6 dbm and the conversion loss is approximately 7.5 db. The double balanced type mixer (DBM) provides excellent isolation between any two ports. And since a DBM can operate over a large bandwidth, the same mixer can be used for UHF and VHF radios. The DBM also provides excellent protection against receiver spurs due to non-linearizes, such as IM and Half-IF. The received signal mixes down to the frequency of the first IF, 45.1 MHz, and enters the IF circuitry.

Intermediate Frequency (IF)

The Intermediate Frequency (IF) section of the portable radio consists of several sections including, the “high” IF, the second LO, the second IF, and the IF IC chip. The first LO signal and the RF signal mix to the IF frequency of 45.1 Mhz, and then enters the IF portion of the radio.

The signal first enters the “high” IF, passes through a crystal filter, is then amplified by the IF amplifier, and then passed through another crystal filter. The first crystal filter provides selectivity, second image protection, and intermodulation protection. The amplifier provides approximately 16 dB of gain to the signal. The signal then passes through the second crystal filter which provides further selectivity and second image protection. The “high” IF has an approximate 3 dB bandwidth of 7 KHz for 20/25/30 KHz models and 4 KHz for 12.5 KHz models.

The filtered and amplified IF signal then mixes with the second local oscillator at 44.645 MHz. The second LO uses an amplifier internal to the IF IC, an external crystal and some external chip parts. The oscillator presents an approximate level of -15 dBm to the second IF mixer, internal to the IF IC.

The output of the mixing of the IF signal and the second LO produces a signal at 455 KHz (second IF). This signal is then filtered by external ceramic filters and amplified. It is then passed back to the IF IC, sent to a phase-lock detector, and demodulated. The resulting detected audio output is then sent to the AFIC to recover the audio.

The IF IC also controls the squelch characteristics of the radio. With a few external parts the squelch tail, hysteresis, attack and delay times were optimized for the radio. The AFIC allows the radio’s squelch opening to be electronically adjusted.

Transmitter

The GP350 VHF and UHF transmitters contain five basic circuits: a power amplifier, an antenna switch, a harmonic filter, an antenna matching network, and a power control Refer to the block diagram and the schematic for more information.

The power amplifier for VHF contains three stages of amplification. For UHF, the power module contains four stages. Both modules require an input signal of 1 mW, a supply voltage of 7.5 volts, and are capable of supplying, at least, 7 Watts of output. The power out of both modules can be varied by changing the voltage on their second stage.

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C119, L112, and part of C112), and at least, one current limiting resistor (R102 for UHF; and R102, R103, and R108 for VHF). In the transmit mode, TX B+ is applied to the circuit to bias the diodes “on”. The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a “high” impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

The harmonic filter consists of part of C112, and L107, C113, L108, C114, L109, and C115. The design of the harmonic filter for both VHF and UHF is that of a Zolotarev design. This particular design is similar to that of a Chebyshev filter except for a large amplitude first ripple (near dc). This type of filter has the advantage that it can give greater attenuation in the stop-band for a given ripple level.

Another feature of this type of filter is that the coils tend to be smaller than with a Chebyshev design. The design of the VHF filter was modified from the Zolotarev design by slightly changing its capacitor values to yield a filter having an input impedance which optimized the efficiency of the power module.

To optimize the performance of the transmitter and receiver into an antenna, a network is used to match the antenna’s impedance to the harmonic filter. For VHF the network consists of C117, L111, and C122. For UHF the network is made up of C117 and L111. Note that, in order to measure the power out of the transmitter, one must remove the antenna and screw in its place a special BNC-to-Phono adapter.

The power control circuit consists of the networks associated with U151, Q156, Q151, Q152, Q155, and U152. The Op Amp U151A and Q156, along with resistor R101, make up a current-to-voltage amplifier whose gain is mainly dependent upon the ratio of R179 to R153. The current to the final stage of the power module is supplied through R101 (0.1 Ohms), which provides a voltage proportional to the current drain. This voltage is amplified and applied to the input of U151B. The resistors at the input of U151A (R151, R152, R154, and R155) keep the voltages at the inputs of U151A below its maximum allowable. These resistors are 1% tolerance parts

to minimize the error produced at the emitter of Q156 resulting from the voltage offset at the input of U151A.

The voltage at the other input of the summing amplifier, U151B, is supplied from two DACs contained within U152. These DACs are controlled by the microprocessor, and provide the reference voltage for the control loop. One of the DACs, that connected to Pin 9 of U152, provides a coarse tune voltage, while the other provides a fine tune voltage. Since the output of the DACs is not zero when they are set to their lowest level, resistor R169 is provided to bias up the minus input of the summing amplifier to compensate for the bias resulting from the DACs.

The error voltage at the input of U151B produces a voltage at its output, which is in turn applied to the series pass transistor, Q152, through its driver, Q151. The voltage at the collector of Q152 is applied to the controlled stage of the power module, which for both VHF and UHF is the module's second stage. The feedback from the collector of Q152 to the emitter of Q151 through R166 is provided to keep the two stages stable. Likewise, the feedback from the collector of Q152 to the minus input of the summing amplifier is to keep the whole control loop stable.

The purpose of Q155 and its associated circuitry is to keep the control voltage on the module below 7.0 volts, which is the maximum allowed for the UHF module.

The purpose of R173 was originally that of providing compensation to the control loop for changes in the supply voltage, TX B+. However, experimentation has shown that this compensation is not really required. Also, thermistor, R170, was provided to enable the shut back of the PA in the event that it would get too hot. This has also been shown to not be required

Frequency Generation Circuitry

The frequency generation circuitry is composed of two main IC's, the Fractional-N synthesizer (U201) and the VCO/Buffer IC (U251). Designed in conjunction to maximize compatibility, the two IC's provide many of the functions which normally would require additional circuitry. The block diagram illustrates the interconnect and support circuitry used in the design. Refer to the schematic for reference designator.

The supply for the synthesizer is from Regulated 5 volts which also serves the rest of the radio. The synthesizer in turn generates a superfiltered 5 volts (*actually 4.65 volts) which powers U251.

In addition to the VCO, the synthesizer must interface with the logic and AFIC circuitry. Programming for the synthesizer is accomplished through the data, clock, and chip enable lines (pins 5, 6, and 7) from the microprocessor, U401. A serial stream of 98 bits is sent whenever the synthesizer is programmed. A 5 volt dc signal from pin 2 indicates to the microprocessor that the synthesizer is locked while unlock is indicated by a low voltage on this pin. Transmit modulation from the AFIC is applied to pin 8 of U201. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio is also run through an internal attenuator for modulation balancing purposes before being outputted at pin 28 to the VCO. A 2.1 MHz clock for the AFIC is generated by the Fractional-N and is routed to pin 11 where it is filtered and attenuated from 2.5 volts to approximately 2 volts.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. The other reference oscillator components external to the IC are C205, C206, R207, and CR203. The 16.8 MHz signal is divided down signal from the VCO. The loop filter, comprised of R201, R202, R205, C201, C214, C215, and C216, provides the necessary dc steering voltage for the VCO as well as filtering of spurious signals from the phase detector. For achieving fast locking of the synthesizer, an internal adapt charge pump provides higher current capability at pin 31 than when in the normal steady-state mode. Both the normal and adapt charge pumps receive their supply from the voltage multiplier which is made up of C202, C203, C204, C231, CR201, and CR202. By combining two 5 volt square waves which are 180 out-of-phase along with Regulated 5 volts, a supply of approximately 12.6 volts is available at pin 32 for the charge pumps. The current for the normal mode charge pumps is set by R203. The pre-scaler for the loop is internal to U201 with the value determined by the frequency band of operation.

VCO

The VCO (U251) in conjunction with the Fractional-N synthesizer (U201) generates rf in both the receive and the transmit modes of operation. The TRB line (U251 pin 5) determines which oscillator and buffer will be enabled. A sample of the rf signal from the enabled oscillator is routed from U251 pin 23, through a low pass filter, to the pre-scaler input (U201 pin 20). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage between 3 and 10 volts when the PLL is locked on frequency.

In the receive mode, U251 pin 5 is grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U251. The rf signal at U251 pin 2 is run through a low pass filter. The rf signal after the low pass filter is the LO RF INJECTION and it is applied to the first mixer at T2.

During the transmit condition, PTT depressed, five volts is applied to U251 pin 5. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U251. The rf signal at U251 pin 4 is run through a low pass filter and an attenuator to give the correct drive level to the input of the PA module (U101 pin 1). This rf signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received by the transmit VCO modulation circuitry at AUDIO IN.

When a "high" impedance is applied to U251 pin 5, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive, transmit, and pre-scaler buffer are turned off. In the Fractional-N, the battery saver mode places the A/D and the modulation attenuator in the off state. This mode is used to reduce current drain on the radio.

GP350 receive (RX) and transmit (TX) circuits are common to both the VHF and UHF models. Most of the radio processing for RX and TX is accomplished in U402, the Audio Filter IC. The Audio Filter IC performs the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter (RX audio)
- TX pre-emphasis amplifier
- Limiter
- Post-limiter filter
- TX deviation digital attenuators
- MIC gain attenuator
- Noise squelch digital attenuator
- Microcontroller port expanders (output only)
- 2.5 Vdc reference source

U402 parameters are programmed from U401 microcontroller ROM and EEPROM data via the serial CLOCK and DATA lines. Unless otherwise indicated, all signal levels refer to standard carrier modulation, 1kHz tone at +/-3kHz deviation.

TX Audio Path

Internal MIC Bias Switch and External PTT Sense Circuits

PNP switch transistor Q407, resistors R453, R454, and capacitor C463 control the operating bias for internal MIC MK401. Q407 is controlled by microcontroller U401 via U402-40, the Audio Filter IC expanded output port. On connecting an external MIC through the side connector adapter, the external PTT sense transistor (Q408) switches "on" when the external PTT is closed. In PTT-equipped accessories, the PTT switch is series-connected with the MIC element. When this PTT is closed, 5-volts "high" is produced on the collector of Q408 and monitored by U401-14. When the collector voltage is "high" (5 volts), the microcontroller configures the radio for transmit mode.

There is no series-wired PTT within the headsets. These accessories always keep the collector of Q408 "high." With headsets, the radio must be programmed for headsets or Audio Sense. When programmed for Audio Sense, on power-up the microcontroller (U401) reads that line 14 is "high" and interprets that there is a headset attached. When the radio is programmed for headsets, the microprocessor ignores line 14 for PTT operation and it "looks" to the VOX detect line on U401-19, or to the internal PTT (U409-42), to transmit the headset audio.

MIC Amplifier

There are two MIC amplifiers inside U409. The MIC-enable line, U409-18, is always biased "on" for VOX applications. The amplifiers are selected according to the bias on U409-20, which is the collector voltage on Q408. The external audio amplifier, U409-21, is active when U409-20 is "high" (5 volts), and the internal audio amplifier, U409-22, is active when U409-20 is low (0 volts). The audio signal then exits U409-19 and proceeds through a low pass network (C516, C517, and R516) into U409-12 and out through U409-11, with R515 providing feedback. This circuit supplies a low frequency "roll off" for improved audio clarity. Capacitor C519 and resistor R518 provide the output bias for the MIC amplifiers.

TX Audio Mute Gate

PNP transistor Q409, and resistors R462 and R463 comprise the TX audio mute gate. The audio Filter IC expanded output port (U402-40), controls Q409 as well as the internal MIC bias switch (Q407). When U402-40 is logic LO state, a small dc current flows from U409-11 MIC amplifier output into Q409 emitter, through Q409, and out of the collector through R462. A fraction of the emitter current flows out of the base through R463 to ground (Vss of Audio Filter IC). MIC audio at U409-11 passes through the TX audio mute gate. When U402-40 is logic "high," Q409 base voltage is 4Vdc (typical) and emitter voltage is 2.4 Vdc, biasing the device well into cut-off. No current flows through emitter to base/collector, and no MIC audio passes. The mute function is enabled (Q409 is "OFF") when modulating DTMF or 5/6 tone (European) Signalling.

Pre-emphasis Amplifier (standard models)

U402, the Audio Filter IC, contains a TX audio pre-emphasis amplifier, with external gain setting resistor R504, and pre-emphasis elements R506 and C462. Connections are made at each end of resistor R506 to provide interconnection of "front cover" option board TX audio through connector P1 (below). Pre-emphasis is 6 dB/octave.

Option Interface Connector P1 (Keypad/Display models)

P1 provides interconnection of "front cover" option PC boards to the GP350 radio main board. MIC audio output is available from P1-5 at a level of 45 mVrms and 10k ohm output impedance. Option TX Audio input to the GP350 radio is available at P1-4 with sensitivity of 40 mV rms, pre-emphasized at 6 dB/octave, and less than 200 ohm output impedance (from option board). If "flat" audio response is required, the audio output from the option board must be de-emphasized at a -6 dB/octave rate, 300Hz to 3kHz, with 0 dB gain at 1kHz. The low option board output impedance is required to achieve better than 40 dB isolation between main board input (P1-4) and output (P1-5) audio.

Limiter (Audio Filter IC)

The audio filter IC U402 contains the limiter circuit, which prevents over-deviation of the RF carrier by symmetrically clipping the peaks of the modulating voltage. Audio from the pre-emphasis amplifier circuit is coupled to the limiter. Gain of the limiter stage is adjustable in four 3 dB steps, from -3 dB to +6 dB. Therefore, TX audio path gain, or MIC gain, can be adjusted to compensate for different sound environments through the Radio Service Software.

Post-Limiter Filter (Audio Filter IC)

Clipped modulating voltage from the limiter output is coupled to the post-limiter filter. Filtering attenuates the spurious products generated by the limiter. The post-limiter filter is programmable to operate in the following modes:

- CEPT/EIA mode
- Japan mode
- FTZ (Germany) mode

PL Encoder

Private Line (CTCSS) is generated by the PL encoder circuit in U402, the Audio Filter IC. Tone PL or Digital PL data is programmed for each mode from the Radio Service Software. On entering transmit mode, TPL or DPL data is programmed to U402 via the serial DATA and CLOCK lines. U401-35 microcontroller output strobes &402-32 PL clock input at a constant rate during DPL encoding, or at a rate determined by the PL encoder algorithm in the microcontroller for TPL encoding corresponding to tone frequency. The encoded PL is summed with MIC audio at the post-limiter filter input. Digital attenuators are employed to adjust the balance of MIC radio and PL to prevent over-deviation of the carrier. PL deviation is adjustable in three “coarse” steps of 500 Hz, 750 Hz, and 1 kHz, for 25 KHz models and steps of 250 Hz, 375 Hz, and 500 Hz for 12.5KHz models with compensation of MIC audio level.

DTMF Encoder

Resistors R424, R425, R426, R428 and R484, and summer U405A form the DTMF encoder. U405A-1 is coupled to U402-13 Audio Filter IC auxiliary TX modulation input.

DTMF encoded signals pass from this input to the post-limiter filter input. U405A-1 is also coupled to U402-12 and coupled through RX audio path to the audio PA for sidetone audio.

Deviation Attenuators (Audio Filter IC)

Carrier deviation is set by programming the digital deviation attenuators of the Audio Filter IC. Deviation data for each mode is entered through the Radio Service Software, and then programmed into U402 from microcontroller U401 on entering transmit mode. U402-19 and U402-20 deviation attenuator outputs are combined through resistors R478 and R479 and dc-coupled to U201-8, the synthesizer modulation input. Capacitor C218 provides a “high” frequency roll-off corner at 20 kHz to further attenuate spurious signals from U402. The dc voltage at the combined attenuator outputs sets the center frequency for the modulated carrier. Any transient (R x C) voltages in the TX audio path must settle within 1 millisecond of PTT activation to prevent center frequency offset.

RX Audio Path

PL Rejection Filter (Audio Filter IC)

The recovered RX audio from the IF detector IC U51 is coupled through capacitor C435 to U402-7 and U402-8 on the Audio Filter IC. RX audio at U402-7 is processed first by the PL rejection filter, which is characterized by a two pole, 300 Hz corner frequency “high-pass” response. Audio then passes through the digital volume attenuator and buffer amplifier output to U402-23. Unattenuated RX audio is coupled to U402-22 and fed to the center-slicer circuit for detection of 5/6 tone (European) signals. For standard test modulation, the audio level at U402-7 is 255 mVrms, and output audio level at U402-23 is 765 mVrms with the digital volume attenuator set to minimum attenuation.

PL Decoder

Recovered RX audio at U402-8, the PL decoder input, first passes through the Tone PL filter, or the Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then coupled to the PL detector circuit, with detected PL output at U402-27. The detected PL signal is coupled from U402-27 to microcontroller U401-64 where algorithms perform the final PL decoding. Data for the Tone PL frequency or Digital PL code for each mode is programmed through the Radio Service Software.

Center-Slicer

The center-slicer circuit U406A detects Quick-Call and 5/6 tone signals. Unattenuated RX audio from U402-22 is dc coupled to the two inputs of U406A. The non-inverting input U406A-3 is fed through resistor R433. Capacitor C415 sets a low-pass corner frequency of 3.3 kHz. The inverting input U406A-2 is fed through resistor R434. Capacitor C416 sets a low-pass corner frequency of 16 Hz. During operation, R434 / C416 establish an averaged dc offset level at U406A-2 dependent on the average dc level of the undetected signal to set the “trigger” threshold of U406A. R433 / C415 provide “high” audio frequency roll-off to improve falsing immunity. The detected output from the center slicer circuit is coupled to microcontroller U401-43 where algorithms perform the final data decoding.

Option Interface Connector P1 (Keypad/Display Models)

P1 provides interconnection of “front cover” option pc boards to the GP350 radio main board. Filtered “flat” RX audio output is available at P1-7, at a level of 765 mVrms at

15k-ohm impedance. P1-7 is always unmuted, not affected by the receiver with squelch circuit. Option RX audio input to the GP350 radio is available at P1-6, with a sensitivity of 100 mVrms at less than 200 ohm output impedance from option board.

RX Audio Mute Gate

PNP transistor Q406, the RX audio mute gate, with resistors R458 and R459, and capacitors C432 and C433, provide receiver audio muting. The RX audio mute gate circuit functions in a similar manner to Q409, the TX audio mute gate circuit. Muting is controlled by microcontroller U401 via U402-39, an Audio Filter IC expanded output port. Q406 is saturated and RX audio unmuted by programming U402-39 to a logic “LO” state. Q406 is placed well into cut-off and RX audio muted by programming U402-39 to a logic “high” state.

Audio Power Amplifier

Variable resistor R460 and resistor R461 provide RX audio volume adjustment. R461 sets the minimum volume level. R466 and R464 form a resistor divider to set the audio input amplitude into the amplifier (U409-10), which is ac-coupled by C518. Fixed level Alert Tone audio is generated by microcontroller U401-56 and coupled through capacitor C437 and resistor R465 into the audio path. The audio amplifier (U409) has three amplifiers designed to differentially drive its load. Two of the three amplifiers simultaneously drive the 16- ohm speaker. All the amplifiers are enabled with “high” (5 volts) on U409-23, which is activated by the AFIC (U402-3). The common amplifier (U409-31 and U409-32) is always on, and either the external amplifier (U409-4 and U409-5) or the internal amplifier (U409-27 and U409-28) is on, depending on the bias of the logic circuits (U409-24). If U409-24 is “high,” the internal amplifier (U409-27 and U409-28) is on; if U409-24 is low, the external amplifier (U409-4 and U409-5) is on. This is how the audio is switched between the internal speaker and the accessories.

Noise Squelch Attenuator

The Audio Filter IC U402 contains a 16 step programmable digital squelch attenuator between U402-16 and U402-18. Noise squelch is set using the Radio Service Software, with open squelch at step 0, and tight squelch at step 15.

Vox Circuit Operation

As mentioned above, with VOX option enabled, a VOX (non-PTT) accessory can be plugged into the adaptor for voice-activated transmit operation. The external MIC element is always supplied with operating bias through resistor R451 and external PTT sense transistor Q408. The external PTT sense at microcontroller U401-14 is therefore, always “enabled.” A second output circuit of MIC amplifier U409-11 couples MIC audio through capacitor C445 to U406B, the VOX detector circuit. Resistors R492 and R493, and capacitor C451 form a syllabic filter which reduces VOX circuit triggering by “high” frequency ambient noise. Resistors R442, R443, R444, R445, and R491, capacitor C423, rectifier diode CR404 and U406B form a linear peak detector circuit. MIC audio causes capacitor C423 to chage to a potential related to the relative amplitude of ambient noise. Microcontroller U401-19 monitors the potential of C423 and establishes a threshold for non-voiced ambient noise. When a positive rise in potential above threshold or voice is detected by an algorithm in the microcontroller ROM, the radio is configured to transmit mode.

INSERT PAGE SIZE AND RADIO BLOCK DIAGRAM FROM
MANUAL 6880902Z30-D, PAGE 2-7

GP350 Portable Radio
Functional Block Diagram

INSERT PAGE SIZE, RECEIVER BLOCK DIAGRAM, TRANSMITTER BLOCK DIAGRAM, VCO BLOCK DIAGRAM, SYNTHESIZER BLOCK DIIAGRAM, AND AFIC BLOCK DIAGRAM FOR MANUAL 6880902Z30-D, PAGE 2-8

Section 5
Troubleshooting

Overview

This section contains three troubleshooting tables for the following GP350 components:

- Receiver
- Transmitter
- Synthesizer
- Microprocessor
- Voltage Controlled Oscillator (VCO)

Troubleshooting Charts

Refer to following pages.

INSERT LINE ART FROM MANUAL

6880902Z30-D, PAGE 4-3

Troubleshooting Flow Chart for Receiver

INSERT LINE ART FROM MANUAL

6880902Z30-D, PAGE 4-4

Troubleshooting Flow Chart for Transmitter

INSERT LINE ART FROM MANUAL

6880902Z30-D, PAGE 4-5

Troubleshooting Flow Chart for Synthesizer

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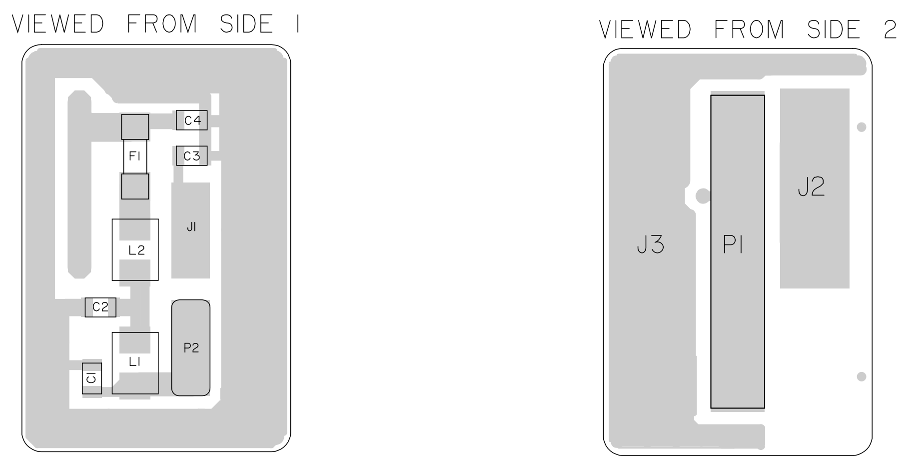
6880902Z30-D, PAGE 4-6

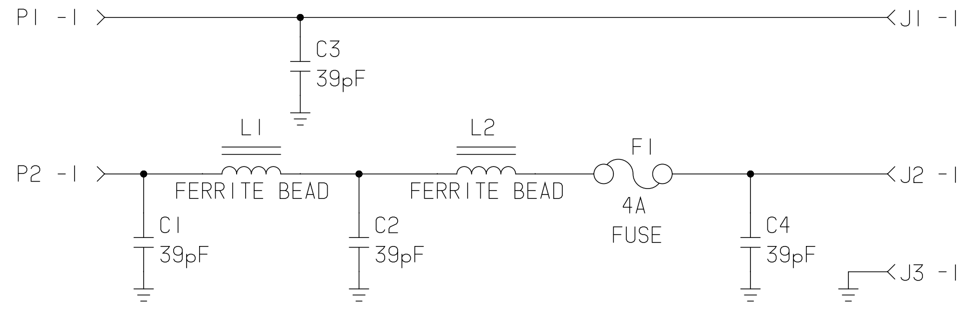
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6880902Z30-D, PAGE 4-7

Troubleshooting Flow Chart for VCO

Battery Filter Board

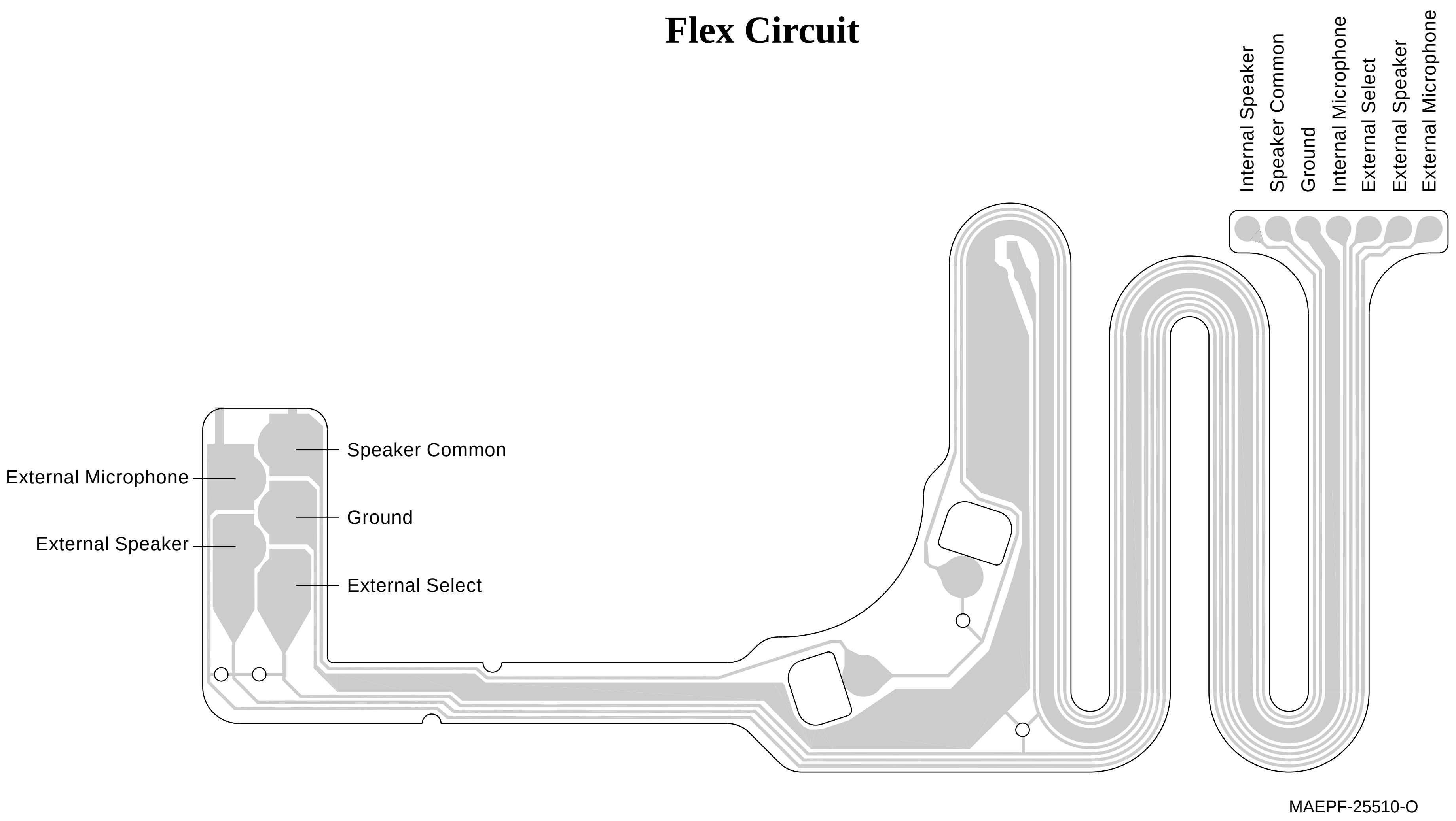


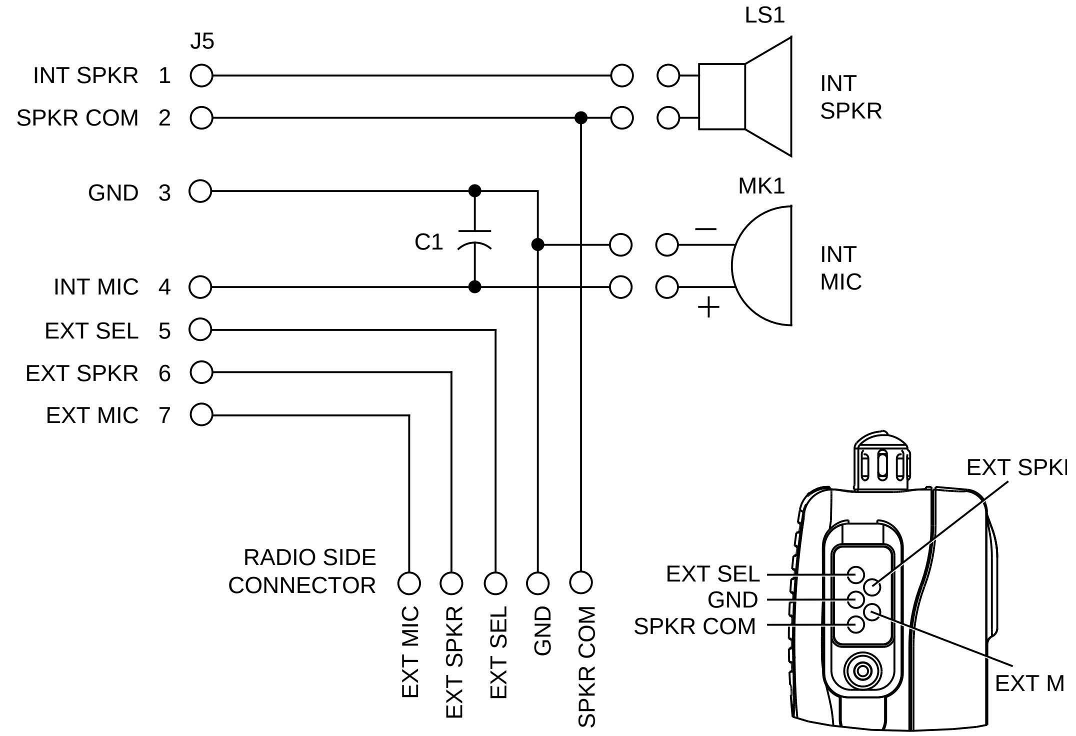


Parts List:
0180702Y89 Battery Filter Board

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C2, 3, 4	2113740A43	39pF ±5%; 50V
		COIL, RF:
L1, 2	2484657R01	Ferrite Bead
		FUSE:
F1	6505663R044	4Amp.

Flex Circuit





Parts List:
Flex Circuit

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C1	2113740A41	33pF ±5%; 50V
LS1	5005589U05	**SPEAKER**
		MICROPHONE:
MK1	5013920A04	**Electret**

Section 616
Section 7
Component Location Diagrams, Schematic Diagrams, and Parts Lists for Battery Filter Board and Flex Circuit

General

Controller components and transceiver components are all part of a single circuit board. Two circuit boards (component location diagrams), VHF and UHF, show transceiver and controller components.

Controller

Any differences in the controller between the VHF and UHF RF bands will be on the controller schematic and parts list.

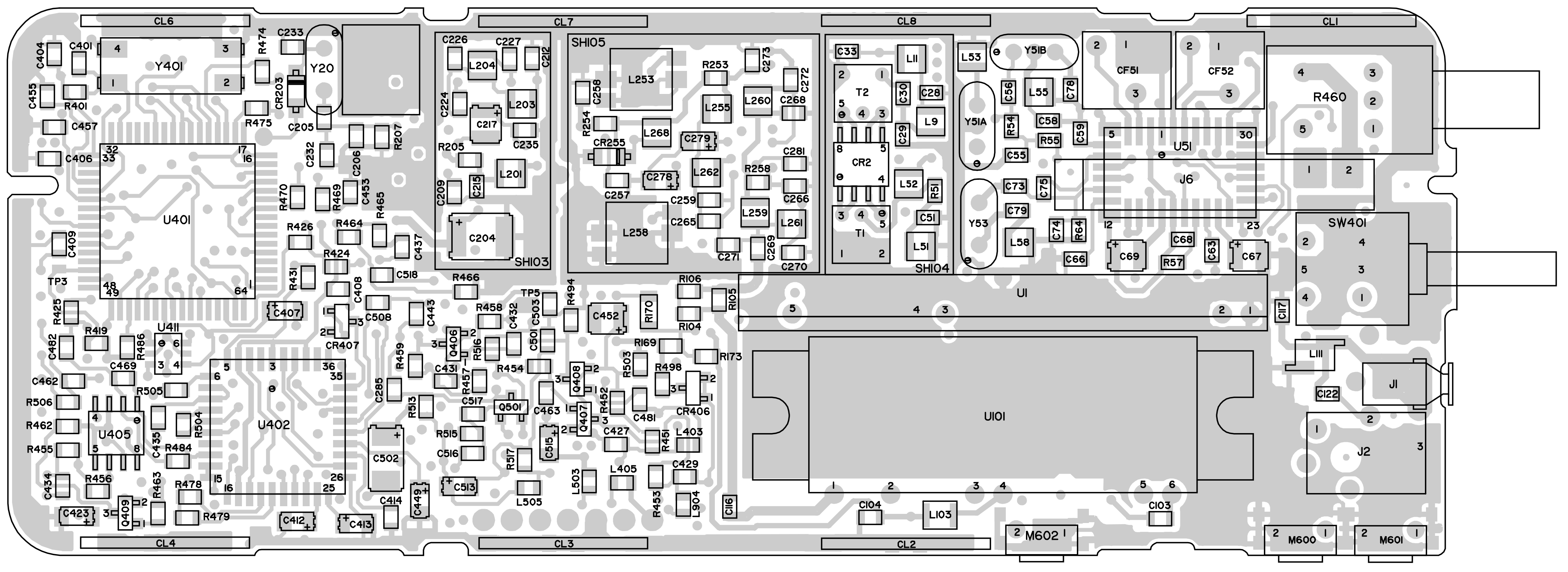
Transceiver

Each bandsplit (VHF or UHF) will include 12.5 and 25KHz channel spacing. Any differences between 12.5 and 25KHz channel spacing will be denoted on the particular VHF or UHF schematic and corresponding parts list.

Schematic Notes

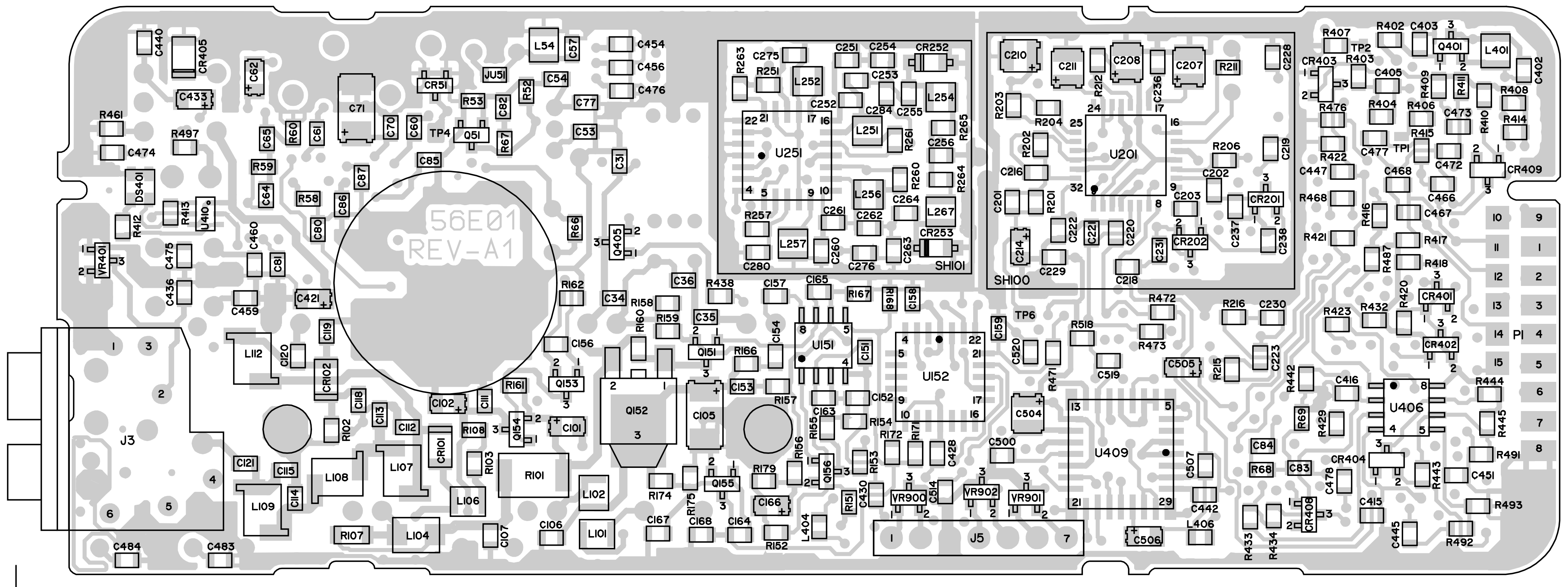
1. Unless otherwise indicated, resistor values are in ohms, capacitor values are in picofarads, and inductor values are in microfarads.
2. Non-polarized capacitors are chip-type unless otherwise indicated.
3. Polarized capacitors are titanium chip-type unless otherwise indicated.
4. “NU” means that a component is not used.
5. DC voltages are measured with a high impedance (10 megohm) DC voltmeter.
6. AC voltages are measured with a high impedance AC RMS voltmeter.
7. All voltages measured are in the receive mode unless indicated otherwise. Indications are as follows:
   (R) Receive Mode
   (T) Transmit Mode
8. Measured in the receive mode with an on-channel unmodulated signal at a level of -20dBm.
9. Measured in the receive mode with an on-channel unmodulated signal at a level of -20dBm, modulated with 1kHz at 3kHz deviation (for 20/25kHz models) or 1.5kHz deviation (for 12.5kHz models), measured with an AC RMS voltmeter.
10. Same as note 8, except with volume control adjusted for 500 milliwatts (2.82 volts RMS across a 16-ohm load connected to the external speaker jack.
11. Measured in the transmit mode with a 1kHz, 11mV RMS signal applied to the external microphone input.

VIEWED FROM SIDE 1



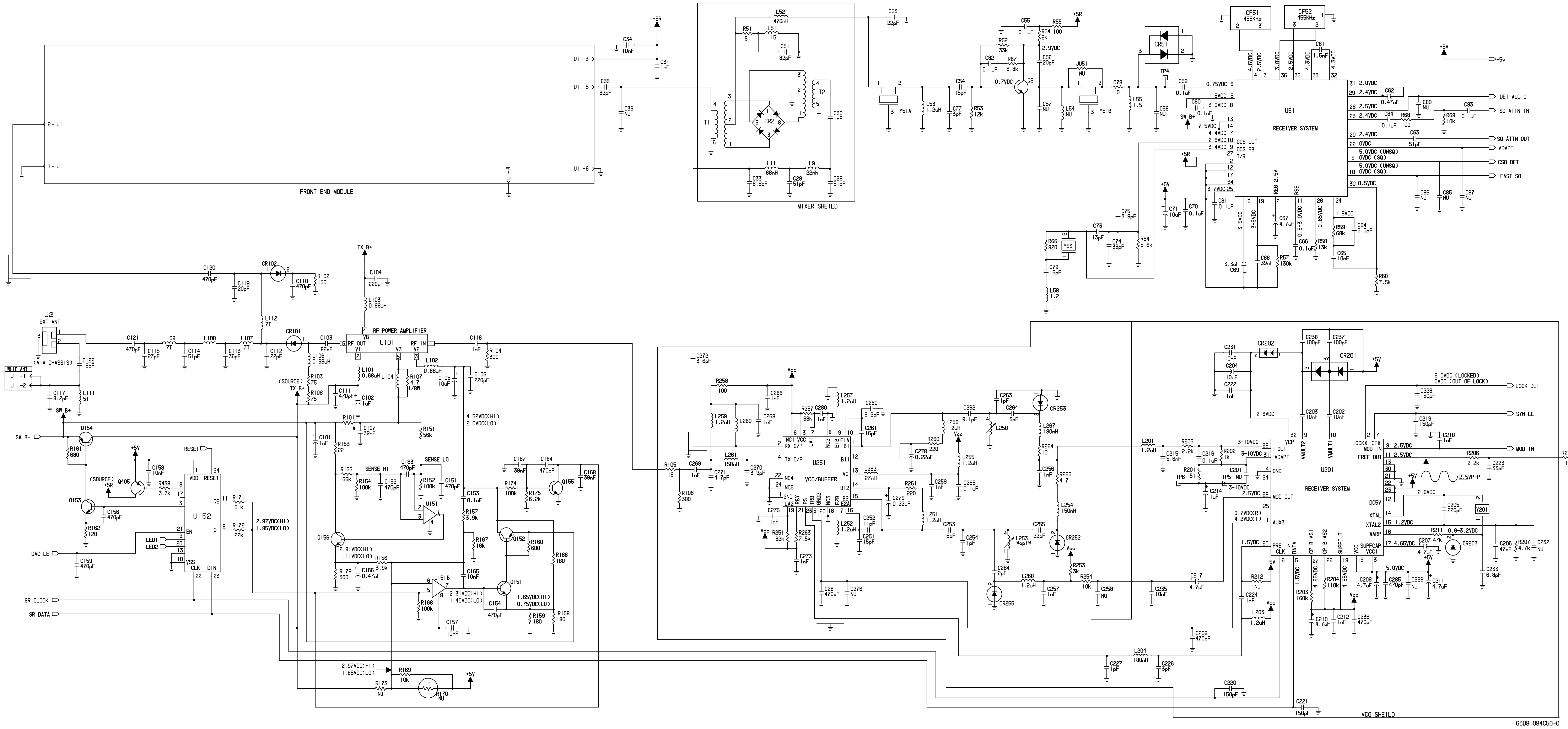
MAEPF-25481-O

VIEWED FROM SIDE 2



MAEPF-25482-O

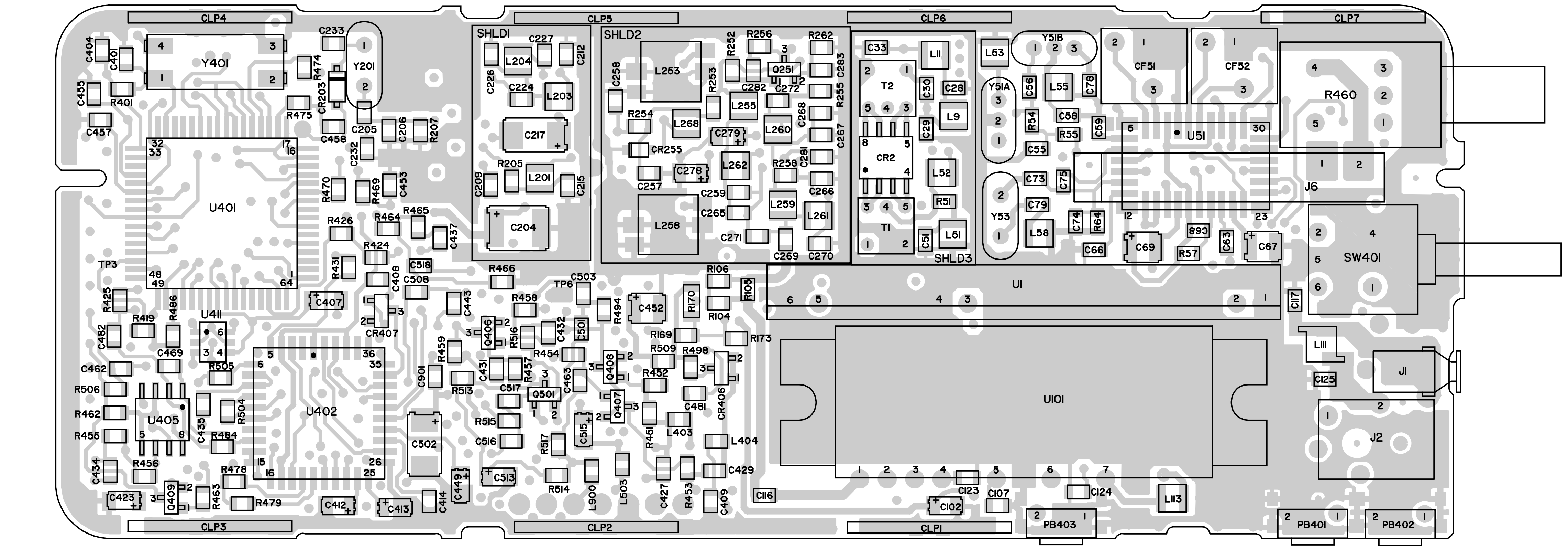
Component Location Diagram for HLD9440A and HLD9441A
VHF, 146-174MHz, Transceiver and Controller



Schematic Diagram for HLD9440A and HLD9441A

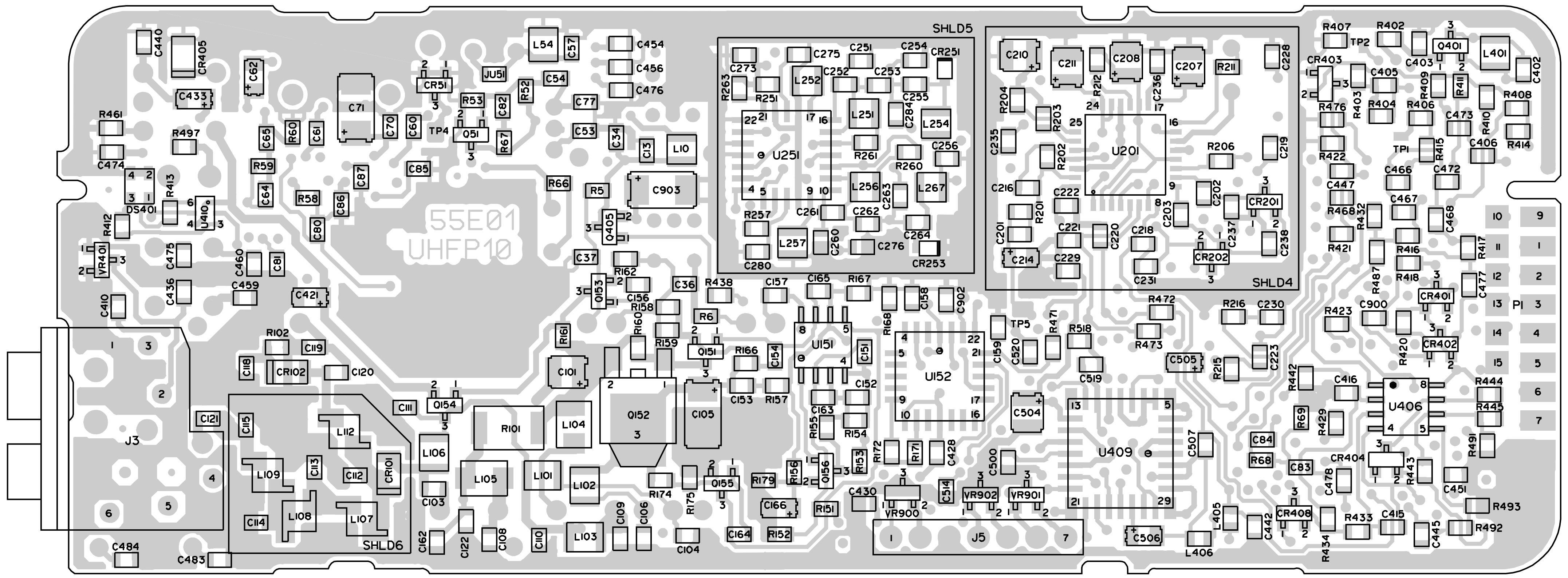
VHF, 146-174MHz, Transceiver Section

VIEWED FROM SIDE 1



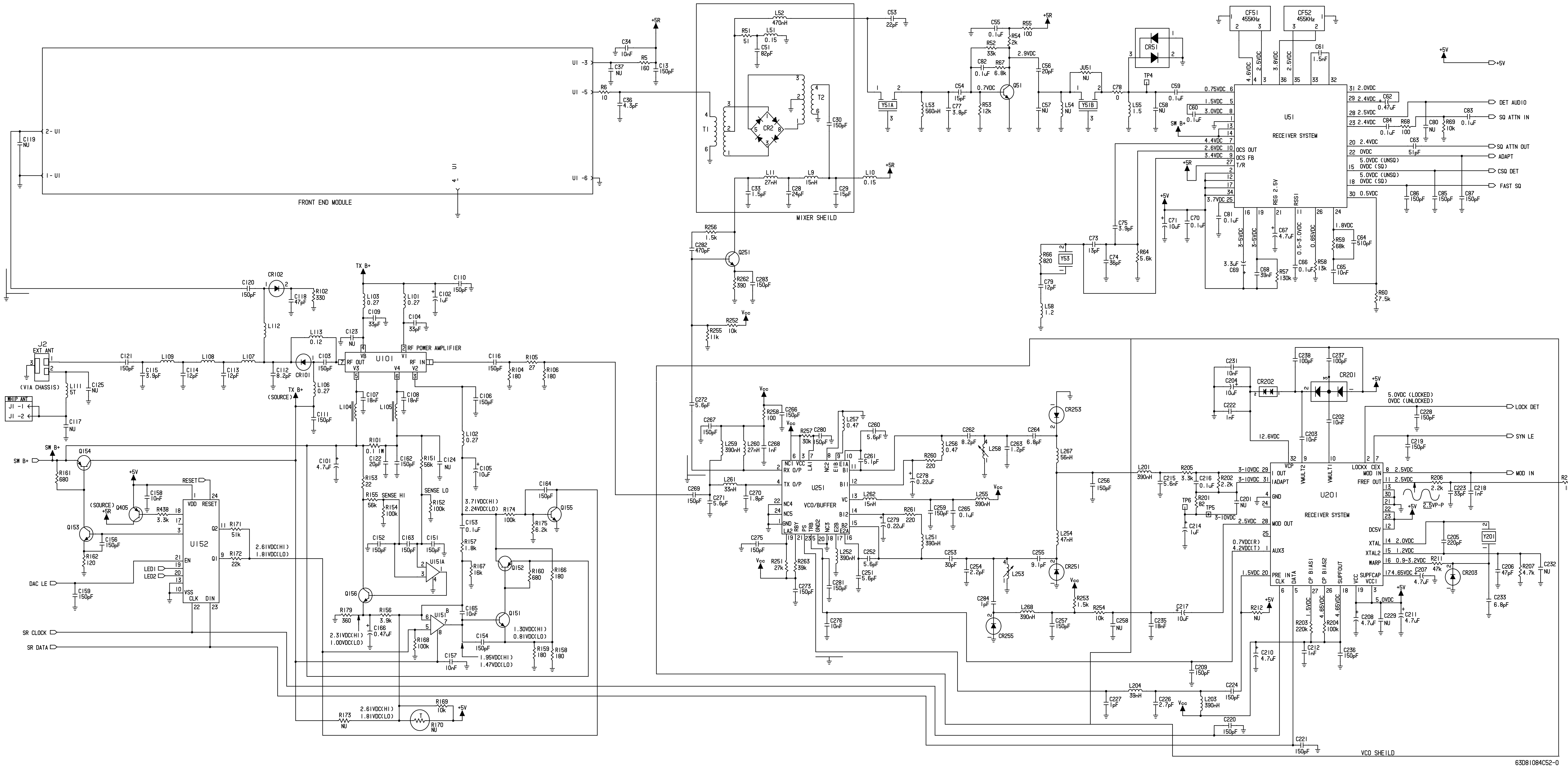
MAEPF-25483-O

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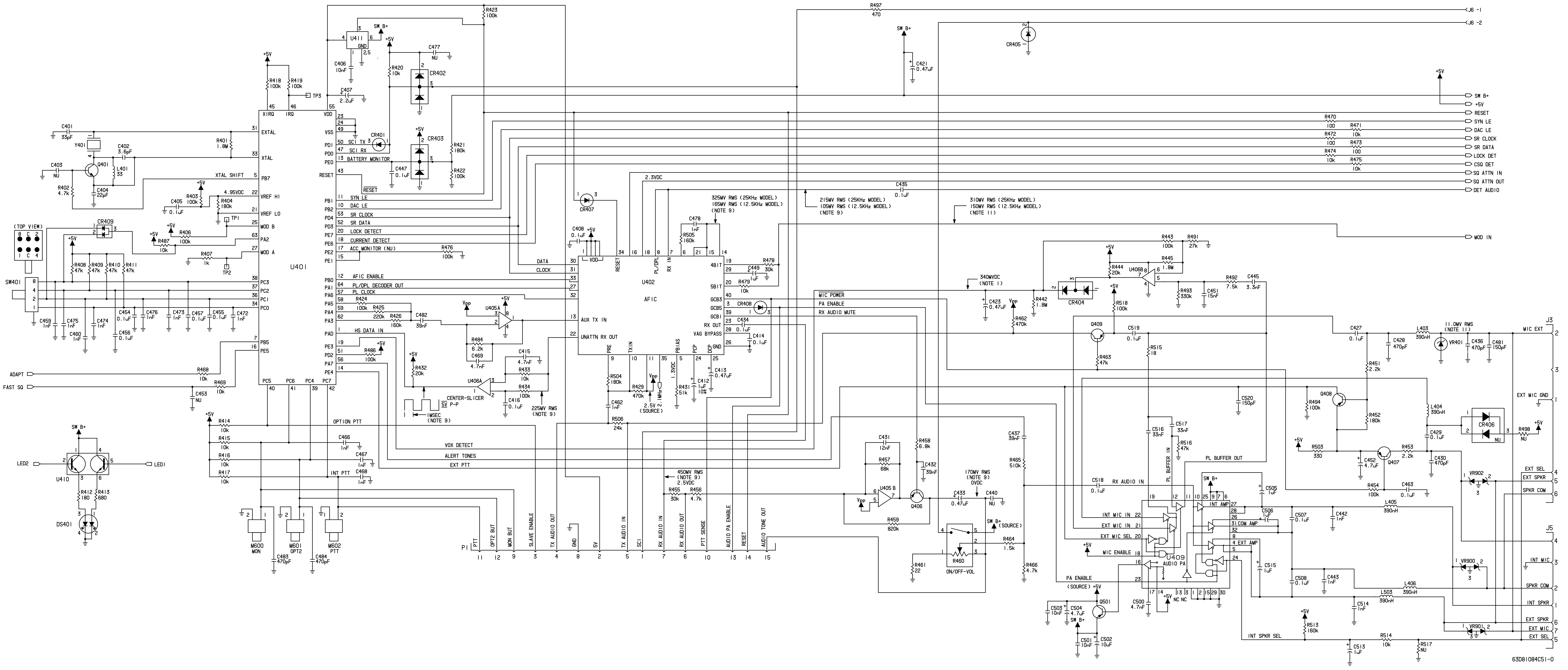


MAEPF-25484-O

Component Location Diagram for HLE9480A and HLE9481A
UHF, 438-470MHz, Transceiver Section



Schematic Diagram for HLE9480A and HLE9481A
UHF, 438-470MHz, Transceiver Section



Schematic Diagram for Controller Section

Parts List: Controller Components (for all bandsplits)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed pF +/-5%; 50V unless stated
C401	2113740A41	33pF
C402	2113740G16	3.6pF
C403		NU
C404	2113740A37	22pF
C405	2160521G37	0.1uF
C406	2113741A45	10nF
C407	2311049A40	2.2uF
C408	2160521G37	0.1uF
C409, 410	2113740A59	150pF, UHF Only
C412	2311049A07	1uF
C413	2311049A05	0.47uF
C414	2160521G37	0.1uF
C415	2113741A37	4.7nF
C416	2160521G37	0.1uF
C421	2311049A05	0.47uF
C423	2311049A05	0.47uF
C427	2160521G37	0.1uF
C428	2113740A71	470pF
C429	2160521G37	0.1uF
C430	2113740A71	470pF
C431	2113741A47	12nF
C432	2113741A59	39nF
C433	2311049A05	0.47uF
C434, C435	2160521G37	0.1uF
C436	2113740A71	470pF
C437	2113741A59	39nF
C440	2113740A71	NU
C442, C443	2113740A79	1nF
C445	2113741A33	3.3nF
C447	2160521G37	0.1uF
C449	2311049A07	1uF
C451	2113741A49	15nF
C452	2311049J11	4.7uF
C453		NU
C454 thru C457	2160521G37	0.1uF
C459, C460	2113741A21	1nF
C462	2113740A79	1nF
C463	2160521G37	0.1uF
C466 thru C468	2113741A21	1nF
C469	2113741A37	4.7nF
C472 thru C476	2113741A21	1nF, VHF
	2113740A59	150pF, UHF
C477		NU
C478	2113740A79	1nF
C481	2113740A59	150pF
C482	2113741A59	39nF
C483, C484	2113740A71	470pF
C500	2113741A37	4.7nF
C501	2113741A45	10nF
C503	2113741A45	10nF
C504	2311049J11	4.7uF
C505, C506	2311049A07	1uF
C507, C508	2160521G37	0.1uF
C513	2311049A07	1uF
C514	2113740A79	1nF
C515	2311049A07	1uF
C516	2113743F12	33nF
C517	2113743F08	33nF
C518	2160521G37	0.1uF
C519	2160521G37	0.1uF
C520	2113740A59	150pF
C903	2311049J27	10uF UHF Only
		DIODE: (see note)
CR401	4880939T01	Shottky Barrier
CR402 thru CR404	4813833C07	Dual
CR405	4880107R01	Rectifier
CR406		NU
CR407, CR408	4813833C07	Dual
CR409		NU
		DIODE:
DS401	4805729G49	Light-emitting
		CONNECTOR, Receptacle:
J5	0180488E01	Controls Flex Connector
J6	0180965Z01	B+, SCI Connector
		COIL, Inductor
L401	2460578C43	33
L403 thru L406	2462587Q42	390nH
L503	2462587Q42	390nH
		CONNECTOR, Receptacle:
P1		Option Board Solder Pads
		SWITCH, Pushbutton:
PB401	4080485C05	MON
PB402	4080485C05	OPT 2
PB403	4080485C05	PTT
		TRANSISTOR: (see note)
Q401	4880214G02	NPN
Q406 thru Q409	4805128M16	SOT, MMBT3906
Q501	4802245J04	PNP
		RESISTOR, Fixed: +/-5%; 1/8W: unless otherwise stated
R401	0660076H31	1.8M
R402	0660076A65	4.7k
R403	0660076B01	100k
R404	0660076B07	180k
R406	0660076B01	100k
R407	0660076A49	1k
R408 thru R411	0660076A89	47k
R412	0660076A31	180
R413	0660076A45	680
R414 thru R417	0660076A73	10k
R418, R419	0660076B01	100k
R420	0660076A73	10k
R421	0660076B07	180k
R422 thru R424	0660076B01	100k
R425	0660076B09	220k
R426	0660076B06	160k
R429	0660076B17	470k
R431	0660076A90	51k
R432	0660076A80	20k
R433	0660076A73	10k
R434	0660076B01	100k
R442	0660076H31	1.8M
R443	0660076B01	100k
R444	0660076A80	20k
R445	0660076H31	1.8M
R451	0660076A57	2.2k
R452	0660076B07	180k
R453	0660076A57	2.2k
R454	0660076B01	100k
R455	0660076A84	30k
R456	0660076A65	4.7k
R457	0660076A93	68k
R458	0660076A69	6.8k
R459	0660076B23	820k
R460	1880143S02	Potentiometer
R461	0660076A09	22
R462	0660076B17	470k
R463	0660076A89	47k
R464	0660076A55	1.5k
R465	0660076B18	510k
R466	0660076A65	4.7k
R468, R469	0660076A73	10k
R470	0660076A25	100
R471	0660076A73	10k
R472, R473	0660076A25	100
R474, R475	0660076A73	10k
R476	0660076B01	100k
R478	0660076A84	30k
R479	0660076A73	10k
R484	0660076A68	6.2k
R486	0660076B01	100k
R487	0660076A73	10k
R491	0660076A83	27k
R492	0660076A70	7.5k
R493	0660076B13	330k
R494	0660076B01	100k
R497	0660076A41	470
R498		NU
R503	0660076A37	330
R504	0660076B07	180k
R505	0660076B06	160k
R506	0660076A82	24k
R513	0660076B06	160k
R514	0660076A73	10k
R515	0660076A07	18
R516	0660076A89	47k
R517		NU
R518	0660076A80	100k
		INTEGRATED CIRCUIT: (see note)
U401	5180598D01	Processor
U402	5105165R77	AFIC
U405	5180932W01	Linear Op. Amp.
U406	5102198J23	Compactor, LM2903D, 50T/R
U409	5105165R65	Audio PA
U410	5180159R01	Dual transistor, NPNs
U411	5180633C01	5V Regulator
		DIODE, Zener: (see note)
VR401	4880140I15	5.6V
VR900	4805117Y01	Dual
VR901		NU
VR902		NU
		CRYSTAL: (see note)
Y401	4880113R01	7.9488MHz

NOTE: For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only. When ordering crystal units, specify type number, frequency, and Motorola part number.

Parts List: HLD9440A and HLD9441A, 146-174MHz VHF Transceiver

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pf +/-5%; 50V: unless otherwise stated
C28, C29	2113740A48	51pF
C30, C31	2113740A79	1nF
C33	2113740A24	6.8pF
C34	2113741A45	10nF
C35	2113740A53	82pF
C36	2113740A18	4.3pF
C51	2113740A53	82pF
C53	2113740A37	22pF
C54	2113740A33	15pF
C55	2160521G37	0.1uF
C56 thru C58	2113740A36	20pF
C59, C60	2160521G37	0.1uF
C61	2113741A25	1.5nF
C62	2311049A05	0.47uF
C63	2113740A48	51pF
C64	2113740A72	510pF
C65	2113741A45	10nF
C66	2160521G37	0.1uF
C67	2311049J11	4.7uF
C68	2113741A59	39nF
C69	2311049J07	3.3uF
C70	2160521G37	0.1uF
C71	2311049J25	10uF
C73	2113740A32	13pF
C74	2113740A42	36pF
C75	2113740A17	3.9pF
C77	2113740A14	3pF
C78	0660076M01	0
C79	2113740A34	16pF
C80		NU
C81 thru C84	2160521G37	0.1uF
C85 thru C87	2113740A59	150pF
C101, C102	2311049A07	1uF
C103	2113740A53	82pF
C104	2113740A63	220pF
C105	2311049J25	10uF
C106	2113740A63	220pF
C107	2113741A59	39nF
C111	2113740A71	470pF
C112	2113740A37	22pF
C113	2113740A42	36pF
C114	2113740A48	51pF
C115	2113740A39	27pF
C116	2113740A79	1nF
C117	2113740A27	8.2pF
C118	2113740A71	470pF
C119	2113740A36	20pF
C120, C121	2113740A71	470pF
C122	2113740A35	18pF
C151, C152	2113740A71	470pF
C153	2160521G37	0.1uF
C154	2113740A71	470pF
C156	2113740A71	470pF
C157, C158	2113741A45	10nF
C159	2113740A71	470pF
C163, C164	2113740A71	470pF
C165	2113741A45	10nF
C166	2311049A05	0.47uF
C167, C168	2113741A59	39nF
C201		NU
C202, C203	2113741A45	10nF
C204	2311049J27	10uF
C205	2113740A63	220pF
C206	2113740G46	47pF
C207, C208	2311049J11	4.7uF
C209	2113740A71	470pF
C210, C211	2311049J11	4.7uF
C212	2113741A21	1nF
C214	2311049A07	1uF
C215	2113741A39	5.6nF
C216	2160521G37	0.1uF
C217	2311049J11	4.7uF
C218	2113741A21	1nF
C219 thru C221	2113740A59	150pF
C222	2113741A21	1nF
C223	2113740A41	33pF
C224	2113740A79	1nF
C226	2113740A14	3pF
C227	2113740A03	1pF
C228	2113740A59	150pF
C229		NU
C230	2160521G37	0.1uF
C231	2113741A45	10nF
C232		NU
C233	2113740G24	6.8pF
C235	2113741A51	18nF
C236	2113740A71	470pF
C237, C238	2113740A55	100pF
C251	2113740A33	15pF
C252	2113740A30	11pF
C253	2113740A34	16pF
C254	2113740A03	1pF
C255	2113740A37	22pF
C256, C257	2113740A79	1nF
C258		NU
C259	2113740A79	1nF
C260	2113740A27	8.2pF
C261	2113740A34	16pF
C262	2113740A28	9.1pF
C263	2113740A03	1pF
C264	2113740A32	13pF
C265	2160521G37	0.1uF
C266	2113740A79	1nF
C268, C269	2113740A79	1nF
C270	2113740A17	3.9pF
C271	2113740A19	4.7pF
C272	2113740A16	3.6pF
C273	2113740A79	1nF
C275	2113740A79	1nF
C276	2113741A45	NU
C278, C279	2311049A03	0.22uF
C280	2113740A79	1nF
C281	2113740A71	470pF
C284	2113740A10	2pF
C285	2113740A71	470pF
		FILTER:
CF51	9180098D06	Ceramic, 3WR (25kHz)
CF52	9180098D05	Ceramic, 3WR (25kHz)
		CLIP:
CLP1 thru CLP8	4280138R02	Butterfly
		DIODE: (see note)
CR2	4880174R01	Ring Mixer
CR51	4880154K03	Dual
CR101, CR102	4880973Z02	Pin
CR201, CR202	4813833C07	Dual
CR203	4805649Q04	Varactor
CR252, CR253	4805649Q04	Varactor
CR255	4805649Q04	Varactor
		CONNECTOR, Receptacle:
J1	3980515C02	Antenna Contact
J2	0180117S05	Antenna Jack
		JUMPER:
JU51		NU
		COIL, Inductor
L9	2462587X45	22nh
L11	2462587X51	68nH
L51	2483411T63	0.15
L52	2462587X61	470nH
L53	2462587N69	1.2uH
L54		NU
L55	2483411T75	1.5
L58	2483411T74	1.2
L101thru L103	2411087B24	0.68uH
L104	2484657R01	Ferrite Bead
L106	2411087B24	0.68uH
L107	2405486C76	7T
L108	2405318D12	7T
L109	2405486C76	7T
L111	2405835C03	5T
L112	2405486C77	7T
L201	2462587N69	1.2uH
L203	2462587N69	1.2uH
L204	2462587X56	180nH
L251, L252	2462587N69	1.2uH
L253	2480145S05	5 1/2 turns, Ferrite Core
L254	2462587X55	150nH
L255 thru L257	2462587N69	1.2uH
L258	2480145S04	4 1/2 turns, Ferrite Core
L259	2462587N69	1.2uH
L260	2483411T62	27nH
L261	2462587X55	150nH
L262	2462587X46	27nH
L267	2462587X56	180nH
L268	2462587N69	1.2uH
		TRANSISTOR: (see note)
Q51	4813827A07	NPN, Small Signal
Q151	4880214G02	NPN
Q152	4813822A10	PNP, 60V, 10Amp.
Q153	4880214G02	NPN
Q154	4880141I03	PNP
Q155, Q156	4880214G02	NPN
Q405	4805128M16	SOT, MMBT3906 (RH)
		RESISTOR, Fixed: +/-5%; 1/8W: unless otherwise stated
R51	0660076A18	51
R52	0660076A85	33k
R53	0660076A75	12k
R54	0660076A56	2k
R55	0660076A25	100
R57	0660076B04	130k
R58	0660076A76	13k
R59	0660076A93	68k
R60	0660076A70	7.5k
R64	0660076A67	5.6k
R66	0660076A47	820
R67	0660076A69	6.8k
R68	0660076A25	100
R69	0660076A73	10k
R101	0680106R01	0.1; 1W
R102	0660076A29	150
R103	0660076A22	75
R104	0660076A36	300
R105	0660076A07	18
R106	0660076A36	300
R107	0611077A18	4.7
R108	0660076A22	75
R151	0660076E91	56k
R152	0660076F01	100k
R153	0660076A09	22
R154	0660076F01	100k
R155	0660076E91	56k
R156	0660076A63	3.9k
R157	0660076A55	1.8k
R158, R159	0660076A31	180
R160, R161	0660076A45	680
R162	0660076A27	120
R166	0660076A31	180
R167	0660076A78	16k
R168	0660076B01	100k
R169	0660076A73	10k
R170		NU
R171	0660076A90	51k
R172	0660076A81	22k
R173		NU
R174	0660076B01	100k
R175	0660076A68	6.2k
R179	0660076A38	360
R201	0660076A18	51
R202	0660076A49	1k
R203	0660076B06	160k
R204	0660076B02	110k
R205, R206	0660076A57	2.2k
R207	0660076A65	4.7k
R211	0660076A89	47k
R212	0660076A73	NU
R215	0660076A49	1k
R216	0660076A82	24k
R251	0660076A95	82k
R253	0660076A60	3k
R254	0660076A73	10k
R257	0660076A89	68k
R258	0660076A25	100
R260, R261	0660076A33	220
R263	0660076A70	7.5k
R264	0660076A01	10
R265	0660076I17	4.7
R438	0660076A61	3.3k
		SHIELD:
SH100	2680521D02	Synthesizer Front
SH101	2680520D02	VCO Front
SH103	2680518D02	Synthesizer Back
SH104	2680692C03	Mixer Back
SH105	2680519D02	VCO Back
		TRANSFORMER:
T1, T2	2580163M03	
		INTEGRATED CIRCUIT: (see note)
U1	0180706Y82	Front End Module
U51	5180207R01	IFIC
U101	5180111R02	Power Amplifier
U151	5180932W01	Linear Op. Amp.
U152	5105226P38	DA Converter
U201	5105457W61	Synthesizer
U251	5105414S84	VCO Buffer
		CRYSTAL:
Y51A, Y51B	9180112R05	45.1MHz Filter
Y53	4880008K02	44.85MHz
Y201	4880114R02	16.8MHz Clock

NOTE: For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only. When ordering crystal units, specify type number, frequency, and Motorola part number.

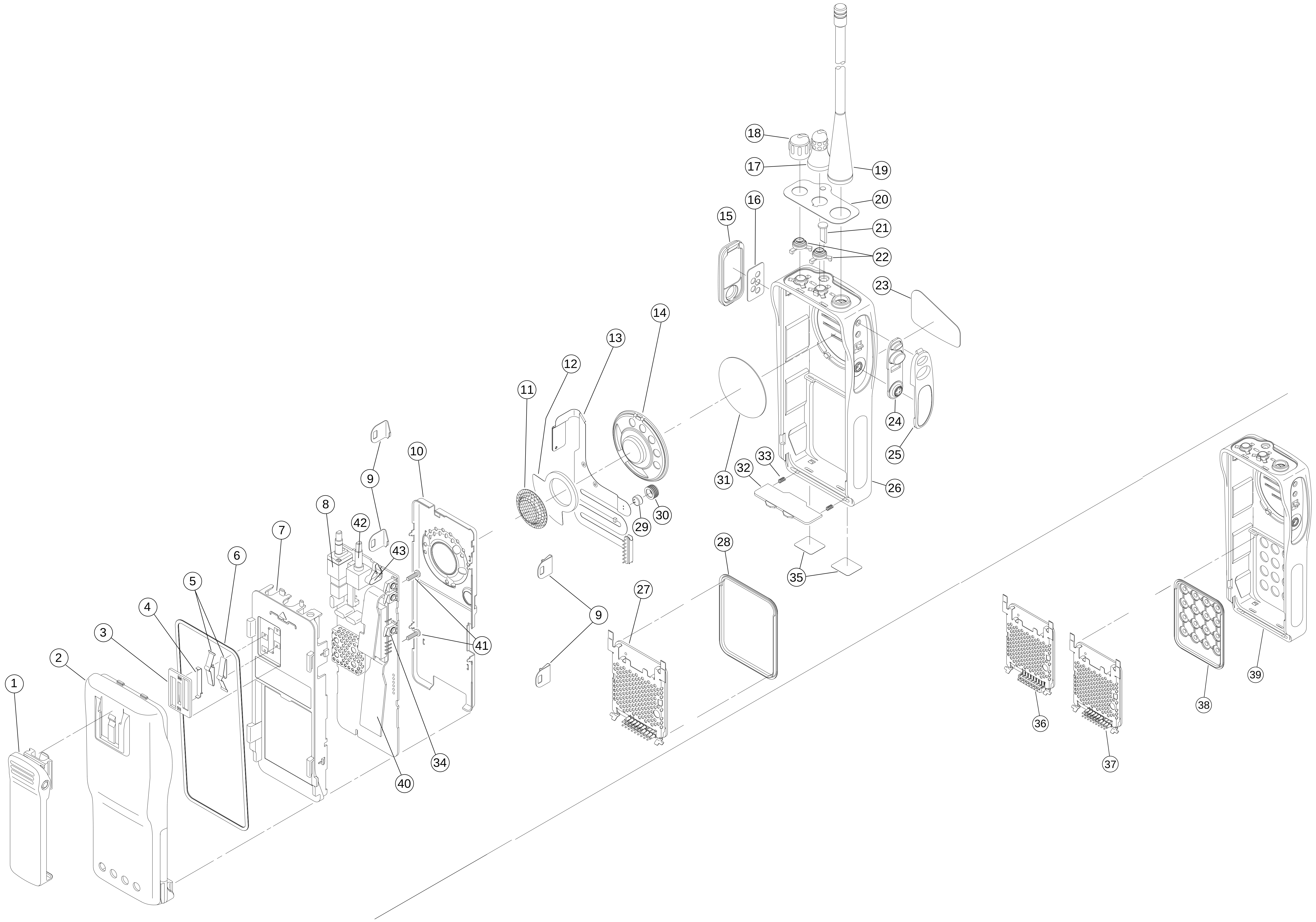
Parts List: HLE9480A and HLE9481A, 438-470MHz UHF Transceiver

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pf +/-5%; 50V: unless otherwise stated
C13	2113740A59	150pF
C28	2113740A38	24pF
C29	2113740A33	15pF
C30	2113740A59	150pF
C33	2113740A07	1.5pF
C34	2113741A45	10nF
C36	2113740A18	4.3pF
C37		NU
C51	2113740A53	82pF
C53	2113740A37	22pF
C54	2113740A33	15pF
C55	2160521G37	0.1uF
C56	2113740A36	20pF
C57, C58	2113740A36	NU
C59, C60	2160521G37	0.1uF
C61	2113741A25	1.5nF
C62	2311049A05	0.47uF
C63	2113740A48	51pF
C64	2113740A72	510pF
C65	2113741A45	10nF
C66	2160521G37	0.1uF
C67	2311049J11	4.7uF
C68	2113741A59	39nF
C69	2311049J07	3.3uF
C70	2160521G37	0.1uF
C71	2311049J25	10uF
C73	2113740A32	13pF
C74	2113740A42	36pF
C75	2113740A17	3.9pF
C77	2113740A14	3pF
C78	0660076M01	0
C79	2113740A34	16pF
C80		NU
C81 thru C84	2160521G37	0.1uF
C85 thru C87	2113740A59	150pF
C101	2311049J11	4.7uF
C102	2311049A07	1uF
C103	2113740A59	150pF
C104	2113740A41	33pF
C105	2311049J25	10uF
C106	2113740A59	150pF
C107, C108	2113741A51	18nF
C109	2113740A41	33pF
C110, C111	2113740A59	150pF
C112	2113740A27	8.2pF
C113, C114	2113740A31	12pF
C115	2113740A17	3.9pF
C116	2113740A59	150pF
C117		NU
C118	2113740A46	47pF
C119	2113740A03	NU
C120, C121	2113740A59	150pF
C122	2113740A36	20pF
C123, C124		NU
C125	2113740A24	NU
C151,C152	2113740A59	150pF
C153	2160521G37	0.1uf
C154	2113740A59	150pF
C156	2113740A59	150pF
C157, C158	2113741A45	10nF
C159 thru C164	2113740A59	150pF
C165	2113741A45	10nF
C166	2311049A05	0.47uF
C201		NU
C202, C203	2113741A45	10nF
C204	2311049J27	10uF
C205	2113740A63	220pF
C206	2113740G46	47pF
C207, C208	2311049J11	4.7uF
C209	2113740A59	150pF
C210, C211	2311049J11	4.7uF
C212	2113741A21	1nF
C214	2311049A07	1uF
C215	2113741A39	5.6nF
C216	2160521G37	0.1uF
C217	2311049J25	10uF
C218	2113741A21	1nF
C219 thru C221	2113740A59	150pF
C222	2113741A21	1nF
C223	2113740A41	33pF
C224	2113740A59	150pF
C226	2113740A13	2.7pF
C227	2113740A03	1pF
C228	2113740A59	150pF
C229		NU
C230	2160521G37	0.1uf
C231	2113741A45	10nF
C232		NU
C233	2113740G24	6.8pF
C235	2113741A51	18nF
C236	2113740A59	150pF
C237, C238	2113740A55	100pF
C251	2113740A21	5.6pF
C252	2113740A21	5.6pF
C253	2113740A40	30pF
C254	2113740A11	2.2pF
C255	2113740A28	9.1pF
C256, C257	2113740A59	150pF
C258		NU
C259	2113740A59	150pF
C260	2113740A21	5.6pF
C261	2113740A20	5.1pF
C262	2113740A27	8.2pF
C263	2113740A05	1.2pF
C264	2113740A24	6.8pF
C265	2160521G37	0.1uf
C266, C267	2113740A59	150pF
C268	2113741A21	1nF
C269	2113740A59	150pF
C270	2113740A09	1.8pF
C271, C272	2113740A21	5.6pF
C273	2113740A59	150pF
C275	2113740A59	150pF
C276	2113741A45	10nF
C278, C279	2311049A03	0.22uF
C280, C281	2113740A59	150pF
C282	2113740A71	470pF
C283	2113740A59	150pF
C284	2113740A03	1pF
		FILTER:
CF51	9180098D06	Ceramic, 3WR (25kHz)
CF52	9180098D05	Ceramic, 3WR (25kHz)
		CLIP:
CLP1 thru CLP8	4280138R02	Butterfly
		DIODE: (see note)
CR2	4880174R01	Ring mixer
CR51	4880154K03	Dual
CR101, CR102	4880973Z02	Pin
CR201, CR202	4813833C07	Dual
CR203	4805649Q04	Varactor
CR251	4805649Q02	Varactor
CR253	4805649Q02	Varactor
CR255	4805649Q02	Varactor
		CONNECTOR, Receptacle:
J1	3980515C02	Antenna contact
J2	0180117S05	Antenna jack
		JUMPER:
JU51		NU
		COIL: Inductor
L9	2462587X43	15nH
L10	2483411T63	0.15
L11	2462587X46	27nH
L51	2483411T63	0.15
L52	2462587X61	470nH
L53	2462587N69	1.2uH
L54		NU
L55	2483411T75	1.5
L58	2483411T74	1.2
L101 thru L103	2411087A19	0.27
L104	2484657R01	Ferrite Bead
L105	2484657R01	Ferrite Bead
L106	2411087A19	0.27
L107 thru L109	2483035N76	Coil, airwound
L111	2483035N13	5T
L112	2483035N76	Coil, airwound
L113	2462587X54	0.12
L201	2462587X22	390nH
L203	2462587X22	390nH
L204	2462587X48	39nH
L251, L252	2462587X22	390nH
L253	2480145S07	1 1/2 turn, brass core, white
L254	2462587X49	47nH
L255	2462587X22	390nH
L256, L257	2462587X61	.47
L258	2480145S08	2 1/2 turn, brass core, violet
L259	2462587X22	390nH
L260	2462587X46	27nH
L261	2462587X47	33nH
L262	2462587X43	15nH
L267	2462587X50	56nH
L268	2462587X22	390nH
		TRANSISTOR: (see note)
Q51	4813827A07	NPN, Small signal
Q151	4880214G02	NPN
Q152	4813822A10	PNP, 60V, 10Amp
Q153	4880214G02	NPN
Q154	4880141L03	PNP
Q155, Q156	4880214G02	NPN
Q251	4813827A07	NPN, Small signal
Q405	4805128M16	SOT, MMBT3906 (RH) 48G22
		RESISTOR, Fixed: +/-5%; 1/8W: unless otherwise stated
R5	0660076A30	160
R6	0660076A01	10
R51	0660076A18	51
R52	0660076A85	33k
R53	0660076A75	12k
R54	0660076A56	2k
R55	0660076A25	100
R57	0660076B04	130k
R58	0660076A76	13k
R59	0660076A93	68k
R60	0660076A70	7.5k
R64	0660076A67	5.6k
R66	0660076A47	820
R67	0660076A69	6.8k
R68	0660076A25	100
R69	0660076A73	10k
R101	0680106R01	0.1 1W
R102	0660076A37	330
R104	0660076A31	180
R105	0660076A11	27
R106	0660076A31	180
R151	0660076E91	56k
R152	0660076F01	100k
R153	0660076A09	22
R154	0660076F01	100k
R155	0660076E91	56k
R156	0660076A63	3.9k
R157	0660076A55	1.8k
R158, R159	0660076A31	180
R160, R161	0660076A45	680
R162	0660076A27	120
R166	0660076A31	180
R167	0660076A78	16k
R168	0660076B01	100k
R169	0660076A73	10k
R170		NU
R171	0660076A90	51k
R172	0660076A81	22k
R173		NU
R174	0660076B01	100k
R175	0660076A68	6.2k
R179	0660076A38	360
R201	0660076A23	82
R202	0660076A57	2.2k
R203	0660076B09	220k
R204	0660076B01	100k
R205	0660076A61	3.3k
R206	0660076A57	2.2k
R207	0660076A65	4.7k
R211	0660076A89	47k
R212	0660076A73	NU
R215	0660076A49	1k
R216	0660076A82	24k
R251	0660076A83	27k
R252	0660076A73	10k
R253	0660076A53	1.5k
R254	0660076A73	10k
R255	0660076A74	11k
R256	0660076A53	1.5k
R257	0660076A84	30k
R258	0660076A25	100
R260, R261	0660076A33	220
R262	0660076a39	390
R263	0660076a87	39k
R438	0660076a61	3.3k
		SHIELD:
SH100	2680521D02	Synthesizer Front
SH101	2680520D02	VCO Front
SH102	2680522D02	Harmonic Filter
SH103	2680518D02	Synthesizer Back
SH104	2680692C03	Mixer Back
SH105	2680519D02	VCO Back
		TRANSFORMER:
T1, T2	2580163M03	
		INTEGRATED CIRCUIT: (see note)
U1	0180707Y42	Front End Module
U51	5180207R01	IFIC
U101	5113829D04	Power Amplifier
U152	5105226P38	DA Converter
U201	5105457W61	Synthesizer
U251	5105414S84	VCO Buffer
		CRYSTAL: (see note)
Y51A, Y51B	9180112R05	45.1MHz Filter
Y53	4880008K02	44.85MHz IF
Y201	4880114R02	16.8MHz Clock

NOTE: For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only. When ordering crystal units, specify type number, frequency, and Motorola part number.

Parts List: GP350 Basic Mechanical

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	HLN8255	CLIP, Spring Belt
2	HNN9360	BATTERY (Also see Accessories)
	HNN9361	BATTERY, FM
3	13-80463E01	ESCUTCHEON, Battery Contact
4	39-80571E01	CONTACT, Programming
5	39-80457E01	CONTACT, Battery
6	32-80545C01	GASKET, Chassis
7	01-80708Y67	CHASSIS
8	18-80143S02	POTENTIOMETER, Volume
9	42-80190R04	CLIP, Locking; 4 Used
10	26-80465E01	SHIELD, Main
11	39-80546B02	CONTACT, Speaker
12	75-80437C01	PAD, Speaker
13	01-80520E02	FLEX, Speaker/Mic
14	50-05589U05	SPEAKER
15	15-80484E01	COVER, Universal
16	13-80458E01	ESCUTCHEON, Universal
17	36-80477E01	KNOB, Freq. 16 Pos.
	36-80477E02	KNOB, Freq. 2 Pos.
18	36-80476E01	KNOB, Volume
19	-	ANTENNA (See Accessories)
20	13-80471E01	ESCUTCHEON, 16 Pos
	13-80471E02	ESCUTCHEON, 2 Pos
21	61-80968Y01	LIGHTPIPE
22	32-80960Y01	SEAL, Control; 2 Used
23	33-80469E01	LABEL, Name
24	75-80466E01	KEYPAD, Push-To-Talk
25	13-80467E01	BEZEL, Push-To-Talk
26	15-80450E01	HOUSING, Radio
27	HLN9208	ASSY, Analog Scrambler (Optional
28	75-80575E01	PAD, Option Board
29	50-13920A04	MICROPHONE
30	14-80577C01	BOOT, Microphone
31	35-80998Z04	FELT, Speaker
32	55-80438B01	LATCH, Battery
33	41-05944K01	SPRING, Coil; 2 Used
34	40-80485C08	SWITCH, Snap (PB401, 2, 3)
35	HLN9480	LABEL, FM Intrinsic
36	HLN9951	ASSY, DTMF Encode (Optional)
37	HLN9208	ASSY, Analog Scrambler w/DTMF
38	75-80470E01	KEYPAD, 16 Key
39	15-80450E02	HOUSING, DTMF
40	42-80126S01	CLIP. P.A.
41	03-00136783	SCREW; 2 Used
42	40-80502B01	SWITCH, Frequency (SW401T)
43	39-80559E01	CONTACT, Antenna (J1)
44	26-80692C02	SHIELD, Mixer
45	26-80519D01	SHIELD, VCO Front
46	26-80518D01	SHIELD, Synthesizer, Front
47	26-80522D01	SHIELD, Harmonic Filter (UHF Onl
48	26-80520D01	SHIELD, Synthesizer Rear
49	26-80521D01	SHIELD, VCO Rear



Exploded Mechanical View and Parts List (Basic)

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HLN9960A DTMF Schematic Diagram and Parts List

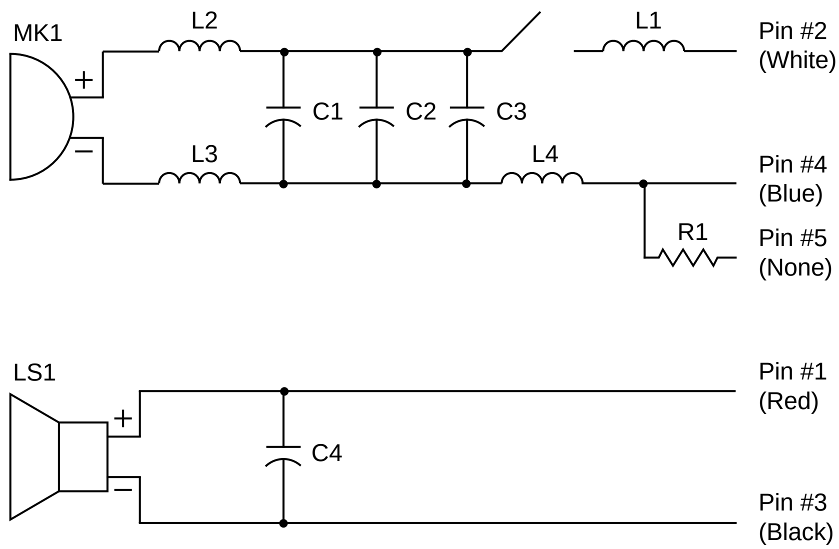
GP300 / GP350 / P110 Chargers & Power Supplies		
Battery Charger	**Rate/Voltage**	**Power Supply**
HTN9630	1 Hour / 120 V	25-80162R01
HTN9702	10 Hour / 120 V	25-80955Z02
HTN9748 (6 unit)	1 Hour / 120 V	25-80427B01
HTN9938 (6 unit)	1 Hour / 100 V	25-80427B01
HTN9802	1 Hour / 220 V	25-80162R02 (European Plug)
HTN9804	10 Hour / 220 V	25-80955Z03 (European Plug)
HTN9811 (6 unit)	1 Hour / 220 V	25-80427B01 (European Plug)
HTN9803	1 Hour / 240 V	25-80162R03 (U. K. Plug)
HTN9805	10 Hour / 240 V	25-80955Z04 (U. K. Plug)
HTN9812 (6 unit)	1 Hour / 240 V	25-80427B01 (U. K. Plug)

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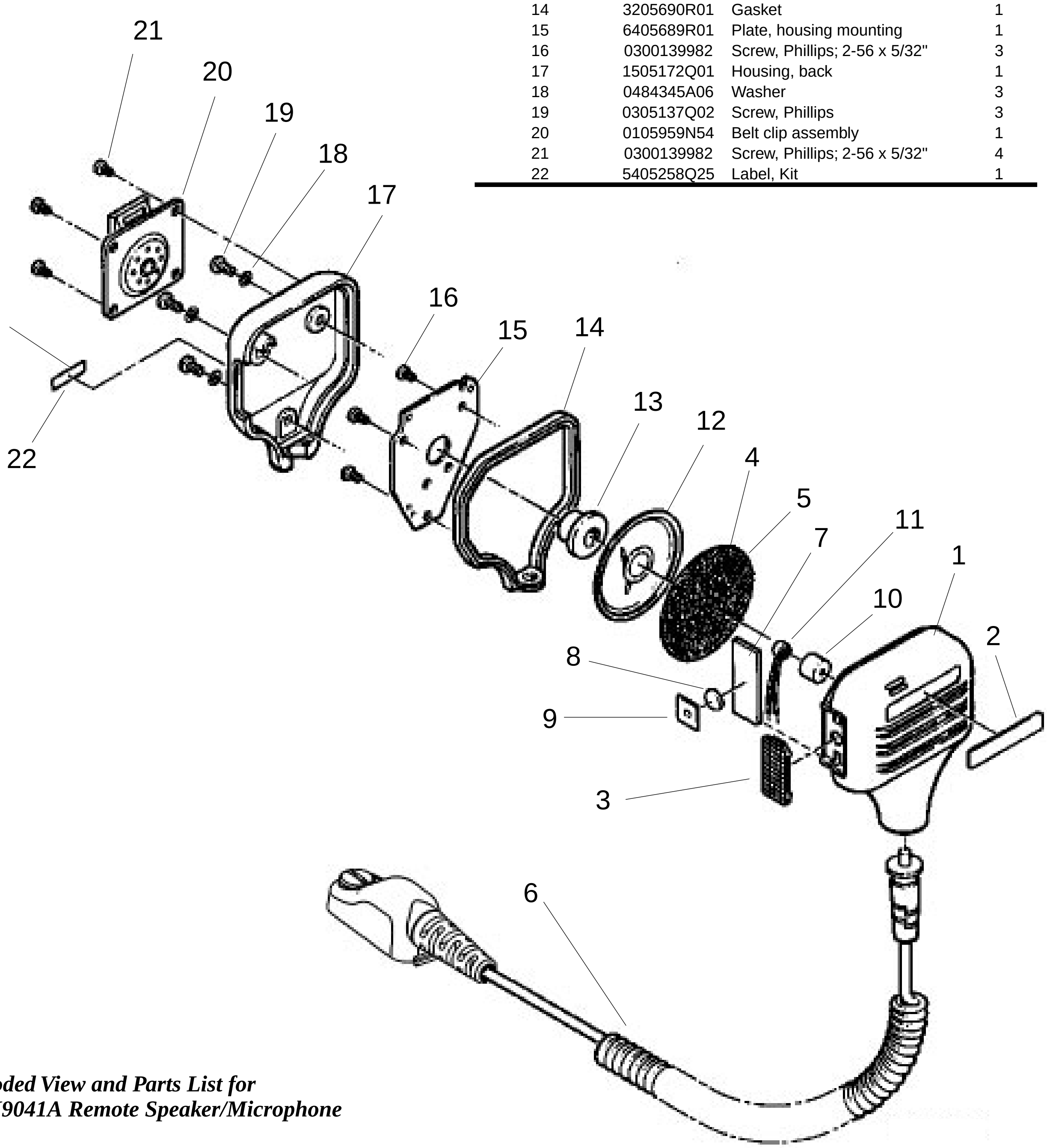
Parts List: HMN9041A Remote Speaker/Microphone

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: uF +/-10%; 100V; unless otherwise stated
C1	2113740A53	82pF, +/-5%, 50V
C2	2113740A67	330pF, +/-5%, 50V
C3	2113741A53	.022uF, +/-5%, 50V
C4	2113741A69	0.1uF, +/-5%, 50V
		COIL, RF:
L1 thru L4	2462575A02	680nH, +/-10%
		RESISTOR, Fixed: Ω unless otherwise stated
R1	0660076M01	0Ω
		SPEAKER:
LS1	**5005910P05**	16Ω
		SWITCH:
S1	3905834K06	Dome, PTT
		MICROPHONE:
MK1	0180703Y69	

‡Provided by remote speaker microphone vendor

Parts List: HMN9041A Remote Speaker/Microphone

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	QTY
1	0105953N42	Front housing, items 1 thru 5	1
2	3305259Q01	Nameplate, Motorola	1
3	4505182Q01	Lever, PTT	1
4	3501152J01	Grille, cloth	1
5	1105461R01	Adhesive	1
6	0180492E01	Acc. Conn. Cable Assembly	1
7	0180703Y67	PCB: includes electrical parts	1
8	3905834K06	Switch: dome, PTT (S1)	1
9	3205231Q01	Seal, dome	1
10	1405219Q01	Boot, microphone	1
11	0180703Y69	Microphone assembly	1
12	5005910P05	Speaker (LS1)	1
13	7505283Q02	Pad, speaker	1
14	3205690R01	Gasket	1
15	6405689R01	Plate, housing mounting	1
16	0300139982	Screw, Phillips; 2-56 x 5/32"	3
17	1505172Q01	Housing, back	1
18	0484345A06	Washer	3
19	0305137Q02	Screw, Phillips	3
20	0105959N54	Belt clip assembly	1
21	0300139982	Screw, Phillips; 2-56 x 5/32"	4
22	5405258Q25	Label, Kit	1



Exploded View and Parts List for
HMN9041A Remote Speaker/Microphone